Engineering Library

DEC 7 - 1931

MAINTENANCE ENGINEERING

IN PLANTS, MILLS, AND FACTORIES

FORMERLY "INDUSTRIAL ENGINEERING"

THE PAST few months have brought upon us an avalanche of salary and wage cuts — another effect of reduced net profit. Justifiable in many cases simply because industrial concerns must live within their incomes.

Few sales, low production, short hours, reduced income for the workers — these conditions are actualities.

In these conditions we see the process of deflation. As always, deflation is accompanied by greatly reduced buying, caused by both lack of money and fear for the future.

The very inactivity in buying is creating a big market for the future; needs are piling up. Eventually a flood of buying must take place.

In the meantime it is most important that we produce our limited output at the least possible cost. Obsolete, worn-out equipment cannot do that job. Modern equipment is needed for greatest net profit.

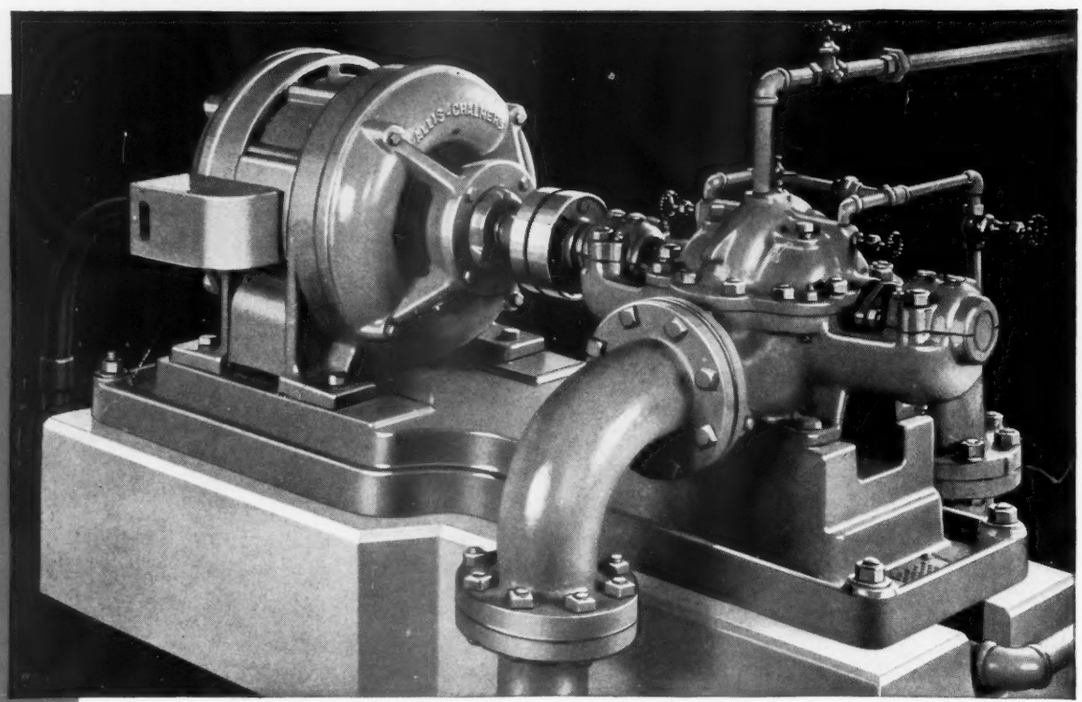
McGraw-Hill Publishing Company, Inc.

a copy

DECEMBER—1931

Good Appearance!

an Allis-Chalmers Mark of Quality Performance



Centrifugal Pumps

The Allis-Chalmers line consists of low, moderate, and high head single stage pumps of 1″ to 72″ discharge, multi-stage pumps for working pressure up to 1500 pounds, high efficiency paper stock pumps, and pumps for special applications.

ALLIS-CHALMERS Centrifugal Pumping Units have a fine substantial appearance and it is a reasonable assumption that they will perform as well as they look. When fine appearance and substantial construction are backed up by nearly fifty years experience building Centrifugal Pumps, purchasers can have confidence in these pumps for their requirements. A trial, however, will be the best proof.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee

YOU production men have only one customer—your sales department. It's up to you to give them a product that in performance, price, appearance, and quality will give them the edge on competition. At the same time you must make net profits on *today's production volume.*

To accomplish this the average plant has made a tremendous investment in production equipment—*but in many cases has failed to get more than 50 to 75 per cent of the machines' operating capacity because of mis-fit drives.* In almost every plant there are machines that to all appearances are operating perfectly—but actually are lazy drones performing at an invisible loss that the operating staff apparently fails to see. We firmly believe that a thorough inspection of your equipment will reveal instances where the production capacity of your machines can be considerably stepped up simply by using the right size and the right type of drives.

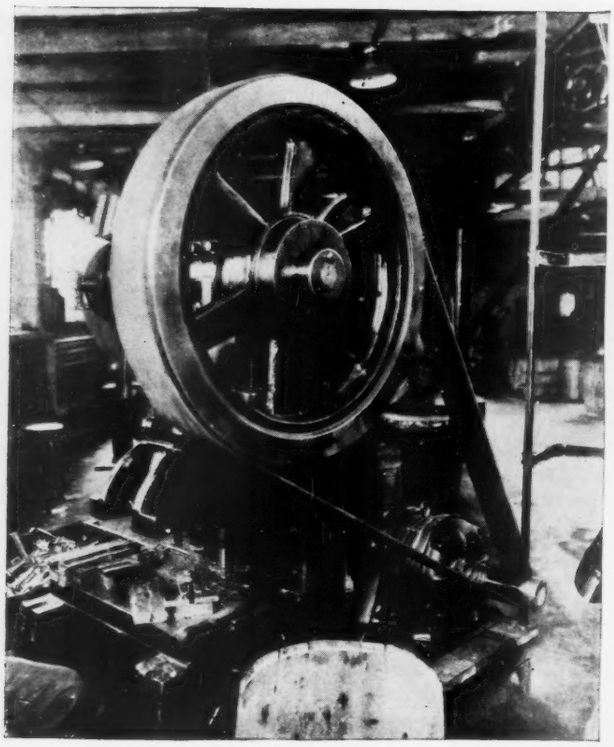
Better use of mechanical power transmission equipment will do one or all of these things in your plant.

1—Increase machine capacity.
2—Lower production costs.
3—Make direct power savings.
4—Improve quality of product.

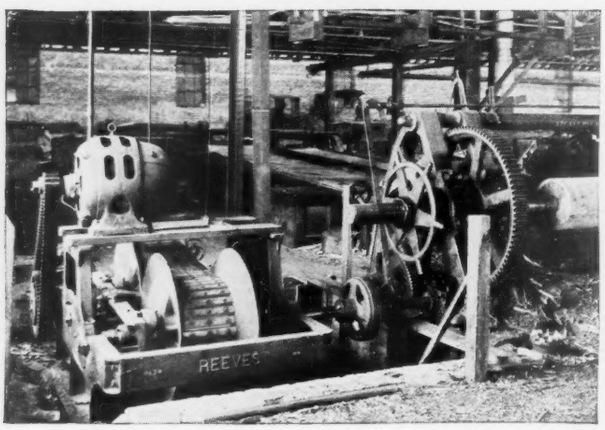
On the following pages you will find many actual examples of how mechanical power transmission equipment has stepped-up machine performance—effecting savings that spell net profits in these days.

STEP UP PERFORMANCE OF

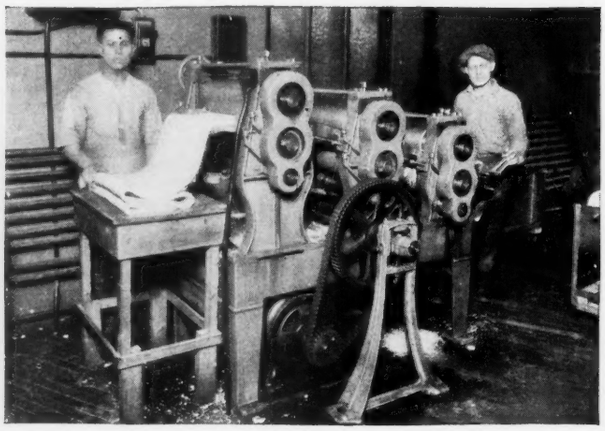
with better applications of mechanical



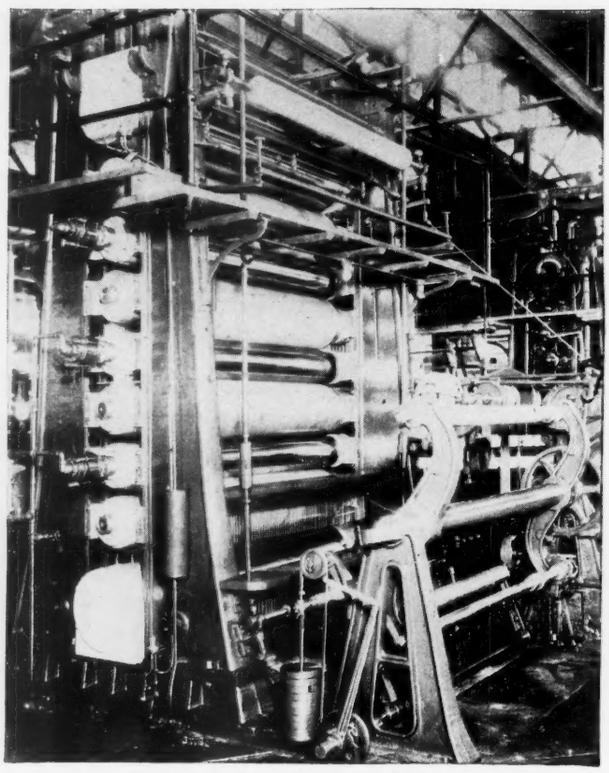
This punch press had a production capacity of 2,500 pieces in a ten-hour day using an extra heavy 6-in. flat belt. Greater production was needed. Close study showed excessive slippage at the peak of the stroke. A light 5-in. special type flat belt was substituted and production was increased to 4,900 pieces a day—an increase of 96 per cent on this one machine. The new belt is standing up perfectly.



A southern box company in cutting down veneer blocks from original diameters as large as 50 in. to a final core diameter of about 7 in. could not maintain anywhere near a constant cutting speed. Congestion, excessive breakage and uneven production resulted. They installed a variable speed transmission on their veneer lathes and were able to maintain a constant cutting speed of 250 ft. per min., relieved congestion, increased production over 27 per cent, and reduced breakage.



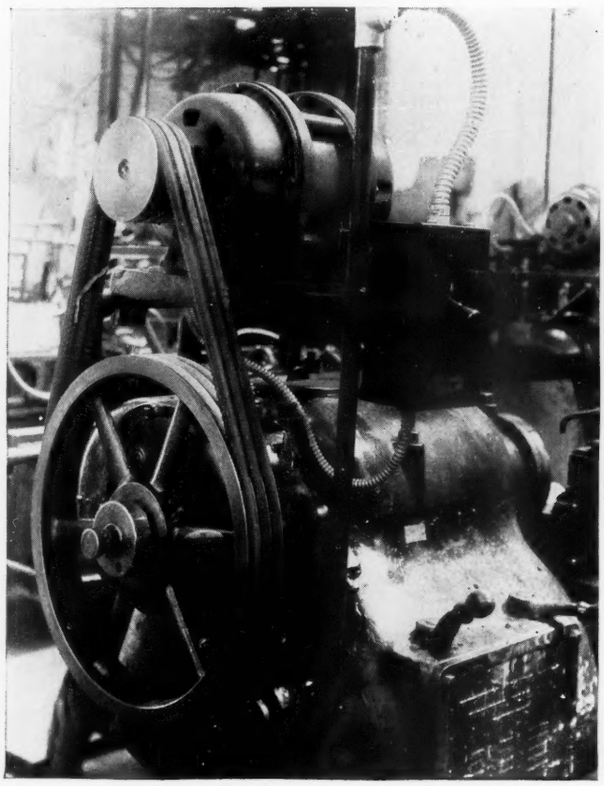
Macaroni dough kneaders put severe service on the drive due to the shock of reversing loads. The production on this machine was stepped up more than 5 per cent—the equivalent of 14 days' straight production per year—by installing the right chain drive for this job. Reverse load starts quickly and evenly and maintenance costs were reduced more than 40 per cent.



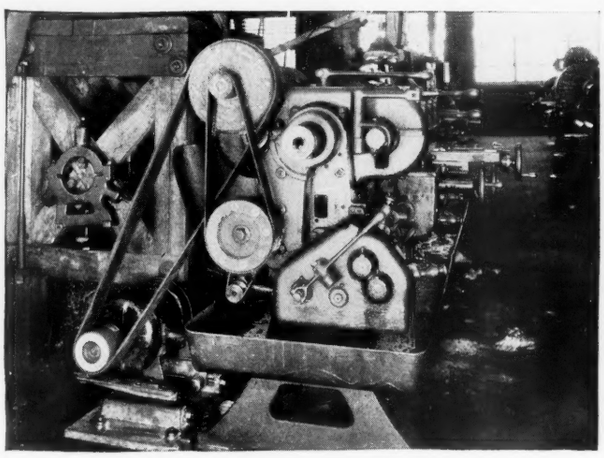
In this paper mill a calender stack was stepped up from a full speed of 900 ft. per min. requiring 167 hp. to 1,200 ft. per min. requiring but 85 hp.—simply with the use of new bearings that were the right type for the job. In addition to this production increase—which amounted to more than 30 per cent—waste loss was reduced as load could be started with all weights on.

YOUR PRODUCTION MACHINES

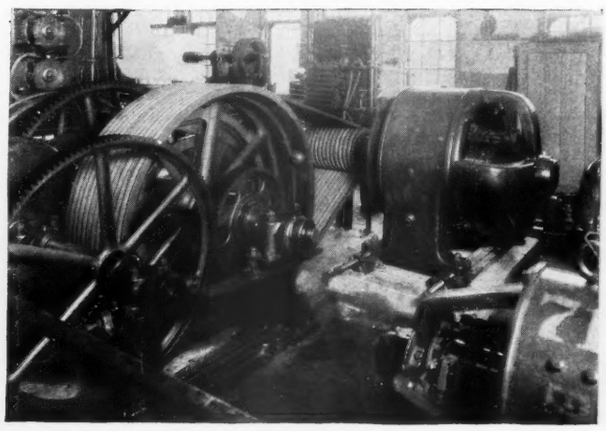
power transmission equipment



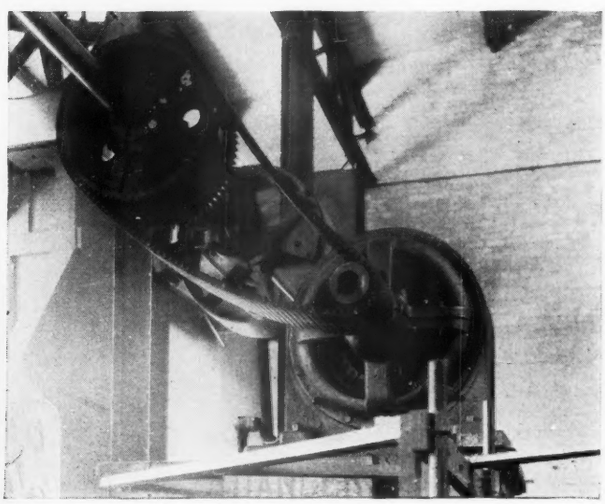
Thirty-three lathes in a large axle and drive shaft plant, were re-equipped with new drives, as shown above. The new drives increased the output so much that a new time study had to be made to set new rates in line with the stepped up production. In addition, a better quality of work with fewer rejects resulted.



Simply by changing the main drive pulley and the two feed pulleys so as to have more power capacity and a more powerful feed, the production on a certain job was doubled on this $2,500 lathe.



Designed to turn out 550 ft. of paper per min. this supercalender had a practical top speed of only 350 ft. per min. due to drive vibration and paper breakage at higher speeds. A new drive as shown was installed with the result that vibration was reduced so that production of 550 ft. of paper per minute was attained without any paper breakage. At time of last report machine had run 4,000 hr. without any trouble—good news to the maintenance engineer. Two machines turned out nearly as much as four machines previously did. In addition, the quality of finish was improved to such an extent that their paper was accepted for a magazine recognized for its fine printing.



"We manufacture steel bars and shapes, fence posts, concrete reinforcing, etc., from old steel rails. The drives on our machines used for straightening cold rails must stand high speed, steel dust, and sudden application of load. We stepped-up tonnage handled by these machines from 2.8 tons an hour to 8 tons an hour by installing chain drives that were the right size and the right type for the job. In addition to increasing production the new chain drives made direct power savings and required but $\frac{1}{12}$ of the maintenance of the old drives."—A large steel company near Chicago.

STEP UP PERFORMANCE OF YOUR PRODUCTION MACHINES

COMPRESSORS

Portable—Gasoline engine, fuel oil engine or electric drive; skid, trailer, motor truck, tractor or rail car mounting

Stationary—Horizontal and vertical; single and duplex; one to four stage; steam, Diesel engine, belt or electric drive; for air, gas or ammonia service

CONTRACTORS AIR TOOLS

Pavement Breakers, Clay Spades, Trench Diggers, Backfill Tampers

ROCK DRILLING EQUIPMENT

Rock Hammers, Drifters, Plug and Feather Drills, Giant Sinkers, Drill Steel, Hose, Accessories, Forging Furnaces, Automatic Heat Treating Machines

MULTI-V-DRIVES

Complete units comprising Goodyear Emerald Cord Belts operating in grooved sheaves

PUMPS

Centrifugal—Horizontal and vertical; single and multiple stage; engine, belt, turbine or electric drive

Steam—Direct-acting and flywheel; horizontal and vertical; simplex and duplex; piston and plunger; simple, compound and triple-expansion; condensing and non-condensing

Power—Horizontal and vertical; single, duplex and triplex; piston and plunger; engine, belt, gear or electric drive

Rotary—Internal or external bearing; belt, turbine or electric drive

Deep Well—Reciprocating type; one, two and three plungers; belt or gear drive—Rotating shaft type; belt, turbine or electric drive.

Sump—Axiflo and centrifugal types

FEEDWATER HEATERS

Open type—for stationary, locomotive and marine services

CONDENSERS AND AUXILIARIES

Surface, Barometric and Jet Condensers; Steam-Air Ejectors, Vacuum Pumps and Special Auxiliaries

METERS

Disc, turbine, compound and piston types; for cold and hot water, gasoline, oil and grease

DIESEL ENGINES

Vertical types for stationary and marine services
Single-acting—two-cycle direct injection, four-cycle air or direct injection
Double-acting—two-cycle air injection

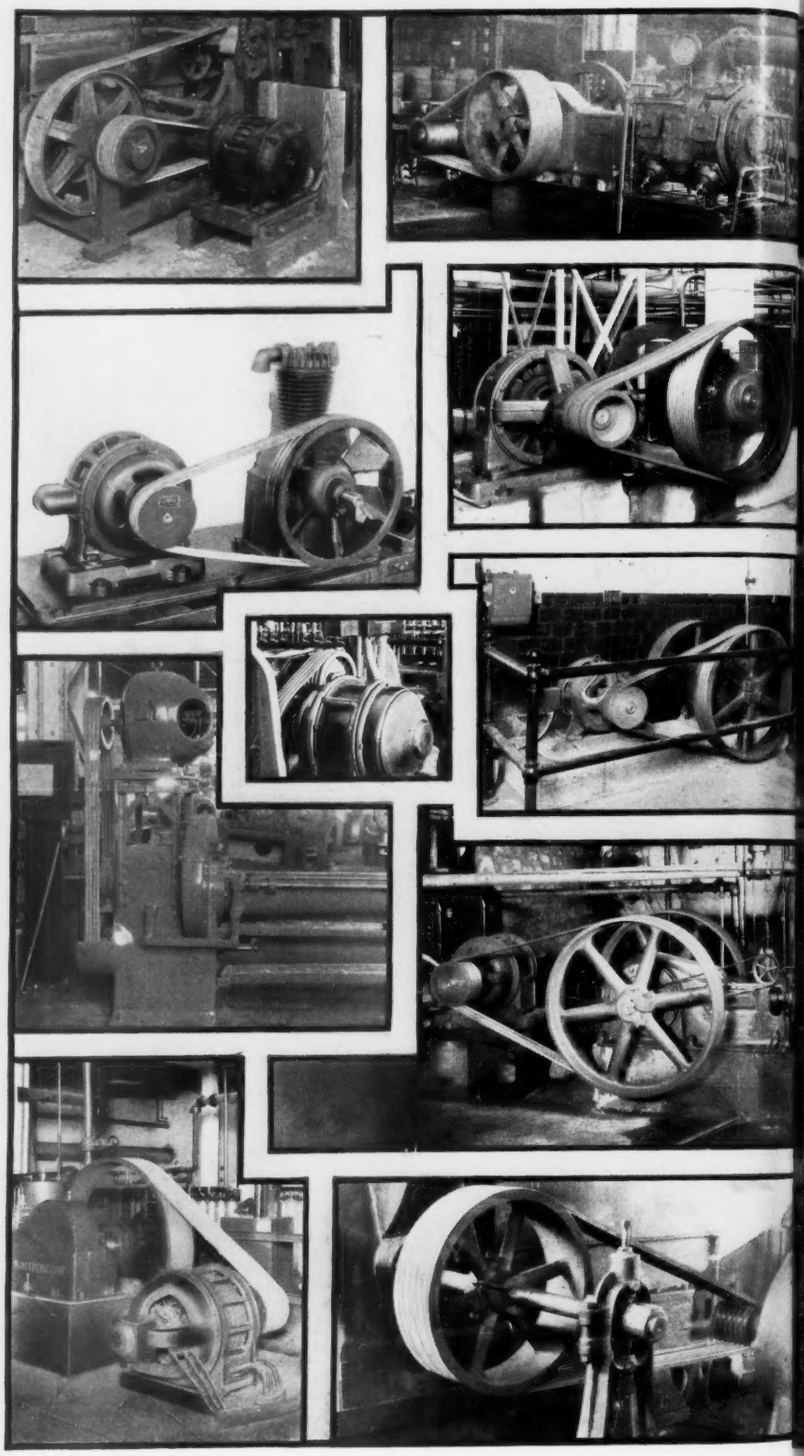
GAS ENGINES

Horizontal double-acting type—for power and gas compressor services
Vertical single-acting type for power service

CHROMIUM PLATING

Complete facilities for heavy plating of machinery parts for salvage and for protection against wear, erosion, corrosion and high temperatures

Literature on Request



Worthington Pump and Machinery Corporation
Harrison, N. J.

☐ You may send me information on the Worthington Multi-V-Drive.

☐ You may send me information on other Worthington products as follows:

_____

Name _____

Street _____

City _____ State _____

Position _____ Organization _____ A

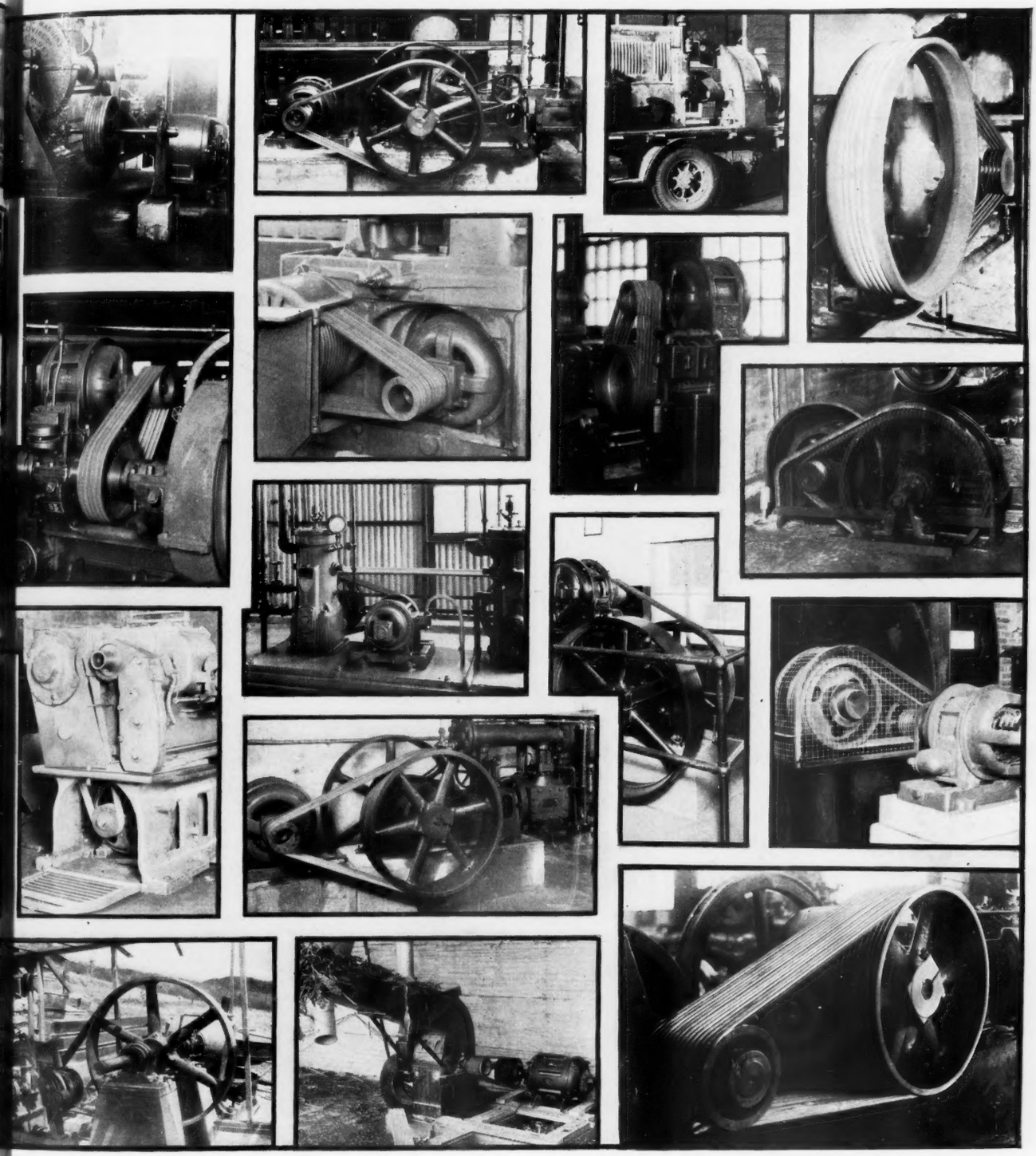
Job-tested

THESE varied applications of Worthington Multi-V-Drives give some idea of the wide utility and the general acceptance of this modern means of power transmission.

Based on the *positive grip* inherent in the design of the equipment, a long list of definite operating advantages accrue to the user.

High percentage of delivered power, high speed ratios, short pulley centers, elimination of idlers and belt dressing, reduction of shock and vibra-

—with better application of mechanical power transmission equipment.



to many needs

tion, decreased maintenance and lubrication costs . . . to mention a few.

Multi-V-Drives are distributed by a nation-wide organization of district offices and mill supply houses. *For further information, just fill in and mail the coupon.*

WORTHINGTON PUMP AND MACHINERY CORPORATION
Works: Harrison, N. J. Cincinnati, Ohio Buffalo, N.Y. Holyoke, Mass.
Executive Offices: 2 Park Avenue, New York, N.Y
GENERAL OFFICES: HARRISON, N. J.
District Sales Offices and Representatives:

ATLANTA	CHICAGO	DALLAS	EL PASO	LOS ANGELES	PHILADELPHIA	ST. PAUL	SEATTLE
BOSTON	CINCINNATI	DENVER	HOUSTON	NEW ORLEANS	PITTSBURGH	SALT LAKE CITY	TULSA
BUFFALO	CLEVELAND	DETROIT	KANSAS CITY	NEW YORK	ST. LOUIS	SAN FRANCISCO	WASHINGTON

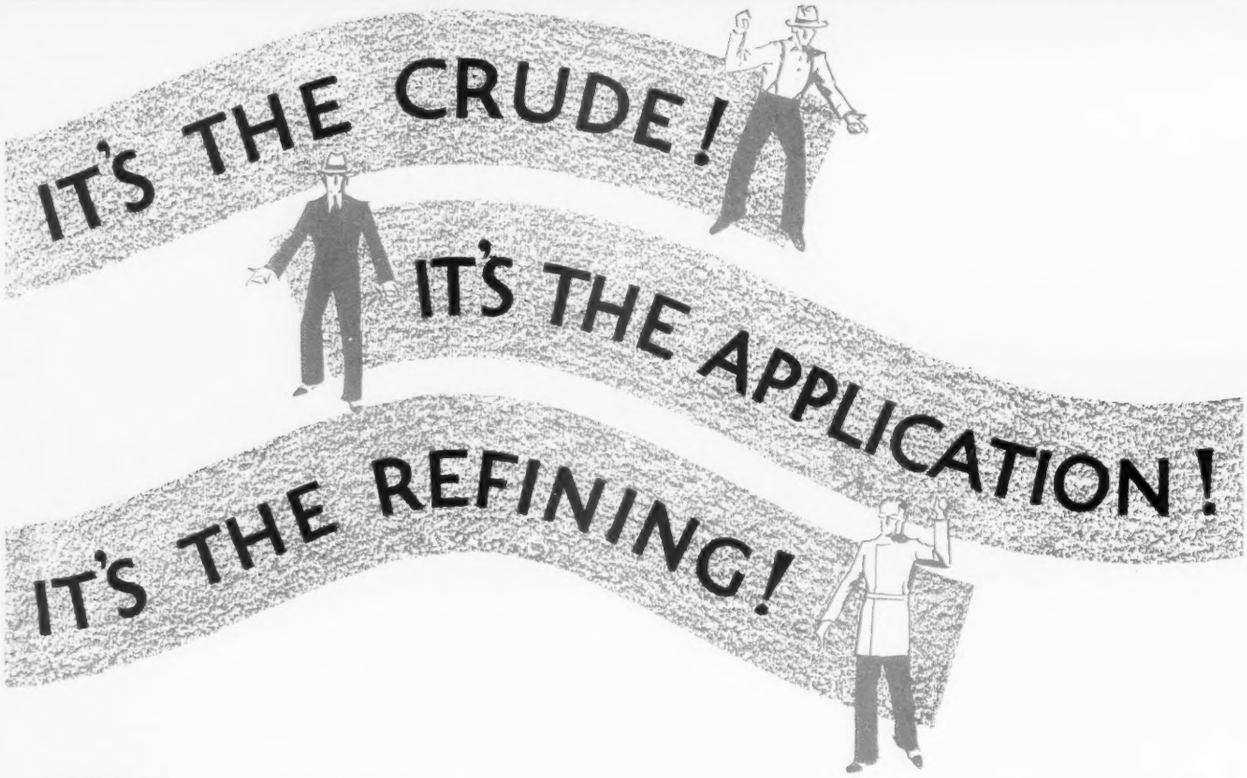
Branch Offices or Representatives in Principal Cities of all Foreign Countries

V-21

WORTHINGTON

MULTI-V-DRIVE

WITH GOODYEAR EMERALD CORD BELTS



They're all wrong-and all right

It is a good and widespread practice today to question traditional methods and to cast eyes inwardly seeking every possible way to prolong machine life and cut maintenance costs. This has brought lubrication squarely to the front. But when you try to select the perfect lubricant, how confusing is the barrage of claims poured into your ears! One group says that the Crude is the Alpha and Omega of lubrication. Another talks Refining, another maintains that Application, (specifying the lubricant for each need) is all that counts.... Aren't *all three* factors equally necessary? All three may be had in Pure Oil's "Three-Point Oil Service". Read the brief summary at the right, then discuss its possibilities in your plant with a Pure Oil engineer.

The Importance of "Three-Point Lubrication Service"

(1) Of course the Crude is important. Pure Oil Crude comes from many fields throughout the country, not from one area producing one kind of crude that must be defended and sold.

(2) Of course Refining is vital. Each Pure Oil field has its own modern refineries. Thus the characteristics of the finished product are controllable; variations are ruled out.

(3) Application is very important, but is handicapped until backed by such Crudes and such Refining as those of Pure Oil. *Then* Application becomes the means for getting greatest results.

In all logic, can't you *expect more* from Pure Oil's "Three-Point Service" than from a one- or two-point proposition?

The PURE OIL *Company*

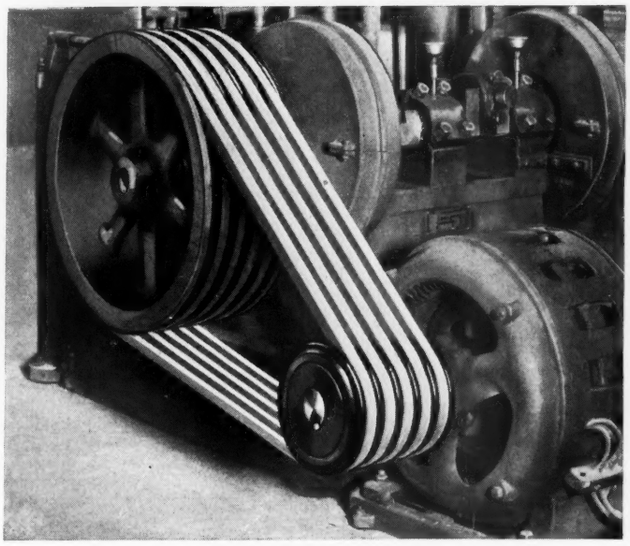
PRODUCERS, REFINERS AND MARKETERS OF A COMPLETE LINE OF PETROLEUM PRODUCTS

REFINERIES:
Marcus Hook, Pa. Heath, O. Toledo, O.
Muskogee, Okla. Ardmore, Okla.
Smith's Bluff, Texas Cabin Creek Jct., W. Va.

BRANCH OFFICES:
Chicago, Bethlehem, Philadelphia, Wilkes-Barre, Akron, Columbus, Cincinnati, Hamilton, Dayton, Canton, Indianapolis, Minneapolis, St. Paul, Pittsburgh, Charleston, Wheeling, New York, Newark, N. J., Troy, Utica

(A5705)

LOOK UNDER YOUR V-BELT DRIVES FOR SAVINGS



WHERE you find rubber dust, you find frequent belt replacements. You need WEDGBELT Pulleys.

WEDGBELT Sheaves of Pressed Steel were designed to save belts. Die-pressed with beautiful accuracy from bright rolled steel, they present a velvet-smooth groove surface for perfect belt contact — a surface that is unscored or roughened by tool marks.

The construction of WEDGBELT Pulleys assures correct angular relation to the belt and uniform belt stress. It likewise provides rapid dissipation of frictional heat, saving the belts from premature deterioration.

A WEDGBELT Pulley — used at least for the driving sheave, where the maximum belt flex and friction occur—will improve the service and reduce the maintenance cost of any V-Belt Drive to a marked degree.

WEDGBELT Pulleys are available through your mill supply dealer, either separately or as a part of complete American WEDGBELT Drives. Whether you buy complete drives or assemble them yourself, it will pay you to specify WEDGBELT Pulleys for V-Drive satisfaction. A new simplified V-Drive Handbook will be sent on request. Write

THE AMERICAN PULLEY COMPANY
4200 WISSAHICKON AVENUE PHILADELPHIA, PA.

AMERICAN WEDGBELT DRIVES

SPEED CONTROL IS COST CONTROL

ACCURATE, FULL-RANGE SPEED CONTROL

—provided by the REEVES Variable Speed Transmission for all types of industrial machines—

STOPS THESE COSTLY PROFIT LEAKS:

Inability to change the speed of a machine to match varying sizes or types of products, variances in materials, or variations in temperature and other influencing factors

$

Excessive percentage of wasted or damaged materials in production, caused by inaccurate machine speeds

$

Inability to balance and control flow of production (production slowed by one or more lagging machines)

$

Inability to provide for variances in the number and skill of operators

$

Expense of machine operator where automatic speed regulation would release him for other work

$

Machines in progressive operations not properly synchronized

NOW READY FOR YOU—

• THIS NEW BOOK ON EFFICIENT SPEED CONTROL

The new REEVES catalog—just off the press—is a highly valuable reference book for industrial executives, production managers, engineers, machine designers and plant maintenance men. It explains the increasing need and application of variable speed control, with specific examples in many industries. Fully describes the extensive line of REEVES Transmissions, including new designs, new controls, new refinements. Also convenient charts, tables, efficiency data and other essential facts. Send coupon today for your copy.

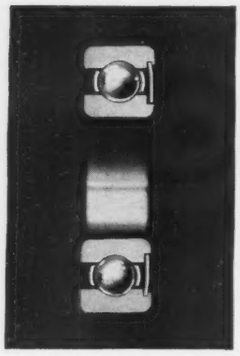
REEVES
Variable Speed Transmission

• MORE THAN 50,000 NOW IN SERVICE •

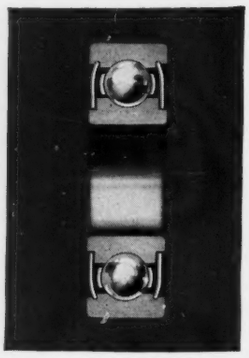
REEVES PULLEY CO., COLUMBUS, INDIANA
Please send me free copy of your new Catalog E-99.

Name.....Company.....

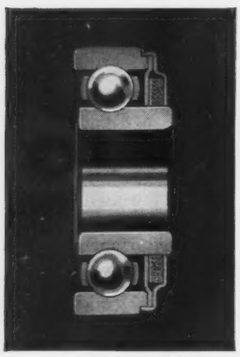
Address.....



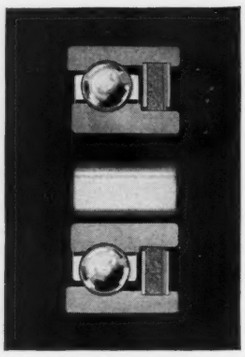
Type P—Closed type ball bearing with one grease-retaining plate.



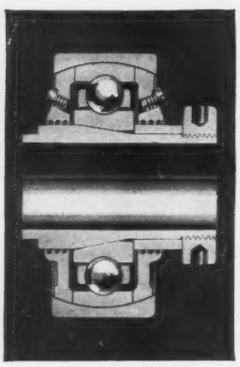
Type PP—Closed type ball bearing with two grease-retaining plates.



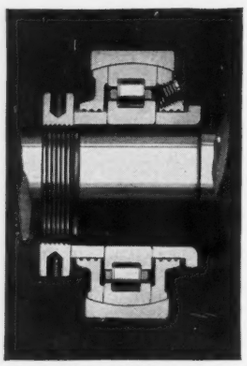
Type GS—"Greaseal" felt-protected, grease-packed ball bearing.



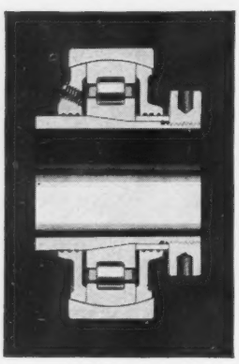
Type EGS—Adjustable, felt-protected, grease-packed ball bearing.



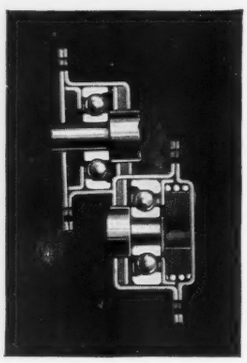
Type LTW—Self-aligning ball bearing with swiveling grease-retaining side plates and adapter sleeve.



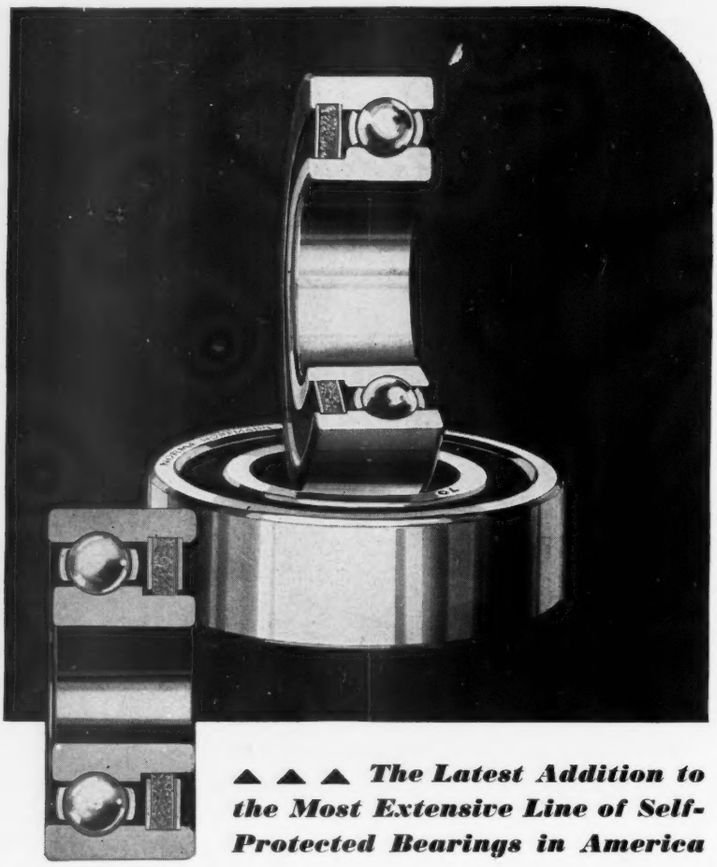
Type RLSW—Self-aligning roller bearing with swiveling grease-retaining side plates.



Type RLTW—Self-aligning roller bearing with swiveling grease-retaining side plates and adapter sleeve.



CUP MOUNTING—Designed to use with small open type ball bearings in high-speed devices; furnished as complete units.



▲ ▲ ▲ ***The Latest Addition to the Most Extensive Line of Self-Protected Bearings in America***

"7000" SERIES

"GREASEAL"

FELT-PROTECTED

BALL BEARINGS

Another all-steel, dust-and-dirt-proof, PRECISION Bearing... Wide, solid inner and outer rings, with maximum contact on shaft and housing...Interchangeable in overall dimensions with other makes...Can be clamped on both sides...Felt seal between removable plates, forming an effective labyrinth against recessed inner ring...Grease-packed for long service...Simplifies construction, reduces costs, improves performance... Made in a full range of sizes.

Other self-protected* PRECISION *Bearings are shown at left. Let our engineers aid in selection and application. Write for Data Sheets 917-C and 926

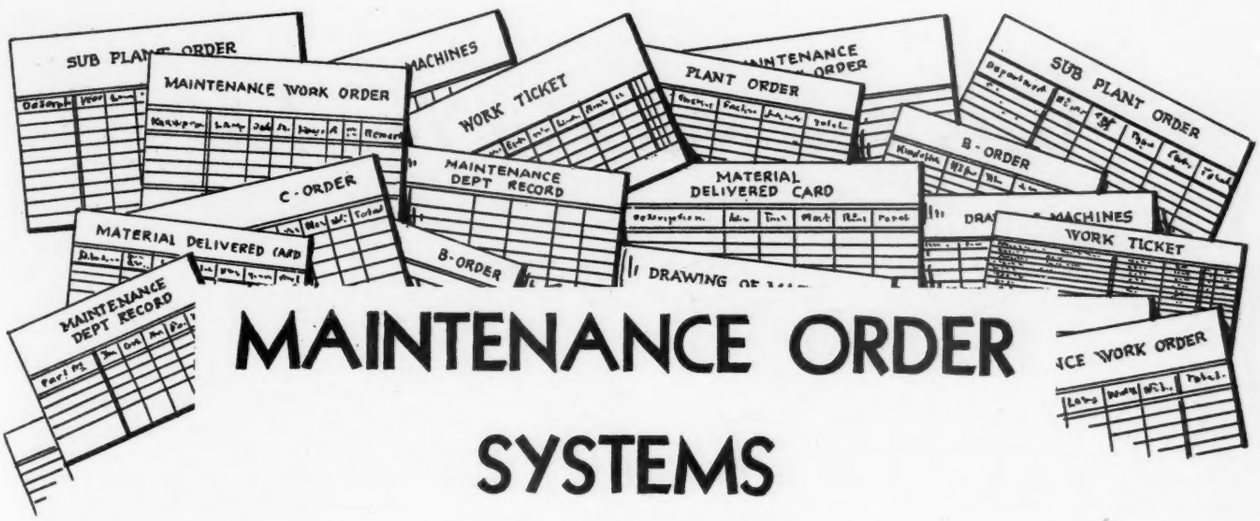
"NORMA-HOFFMANN"

NORMA-HOFFMANN BEARINGS CORPN.- STAMFORD CONN. U.S.A.

MAINTENANCE ENGINEERING

Founded 1882 — McGraw-Hill Publishing Company, Inc.

DECEMBER, 1931



MAINTENANCE ORDER SYSTEMS

THIS article introduces a series of ten which will discuss various maintenance forms and maintenance order routines used by representative plants throughout the country.

The subject of forms involves many ramifications, and each plant presents an individual problem. Therefore, the series will confine itself to precept by example, and forms actually in use will be cited and illustrated.

In effect, the articles will form a "case study" of plant practice in respect to maintenance routine.

G. I. ROSS

Chief Engineer, MacDonald Bros., Inc.
Boston, Mass.

THE MAINTENANCE order routine, as it exists in manufacturing plants throughout the country, varies from the practice which requires no written order to the other extreme in which a written request, followed by a formal estimate, is prepared. In the latter case, the estimate frequently has to run the gamut of more than one executive for endorsement before the formal maintenance order is issued. After this, the order may be sent to the Maintenance Job Control Office, where requisitions are prepared, individual work orders issued, and the job planned in much the same manner as a production order would be planned and scheduled in the Production Planning Department of a factory.

Purpose of the Order Routine. The purpose of any order routine is to provide machinery which will convey all necessary information to all parties concerned and thus insure the execution of the work as intended. The use of paper forms for this purpose not only is a convenient means of transmitting the information, but also serves as a record that the information has been transmitted, and provides data for future comparisons and reference.

Basically, the maintenance order routine should be

designed to perform the following services:

(a) To advise the Maintenance Supervisor of work which is to be done.

(b) To advise the management of contemplated maintenance expenditures and to provide a control of these expenditures.

(c) To advise the Cost Department that money has been expended for maintenance purposes and to provide for the proper allocation of these expenditures.

(d) To provide records for the Maintenance Supervisor by means of which he may control his department.

(e) To make possible a systematic handling of routine inspection for preventive maintenance.

The absence of a written maintenance order is poor practice and a most positive indication of lax operating methods. It should be appreciated, however, that the extent to which the maintenance order routine is developed is entirely dependent upon the type and size of the manufacturing plant concerned, and in any case the results obtained must justify the expense of maintaining the system.

For the small plant few forms are necessary, because the maintenance forces are not departmentalized to a great extent, and the management usually is in close contact with all activities. In a plant of, say, 250 employees or less, a simple maintenance work order form and a material requisition should suffice. In addition there should be a time card for recording the time of arrival at or departure from the plant. As the plant increases in size or in complexity of maintenance activities, additional forms are required.

Next month the system in use at a hardware plant of 250 employees will be described, under which efficient maintenance control is obtained with only one form.

Does Your Motor Fit Your Job?

JAS. B. HOLSTON
Wagner Electric Company, St. Louis, Mo.

ALTERNATING current motors usually are thought of as belonging to one of two types—squirrel cage or slipring. In recent years, however, standard squirrel cage motors have been modified until there are now seven types, each distinct from the original design in one or more features. Furthermore, these seven types are now so-called "standard designs" and are listed as such by motor manufacturers. I shall describe the seven standard types, and give their important characteristics together with the applications for which each is best suited.

■

In the old days you wouldn't have let a donkey pull a coach-for-four, or used a well-groomed livery horse on a peddler's cart. Today the choice of a squirrel cage motor for a specific application calls for no less acumen in adapting drive to job. Mr. Holston describes the seven distinct "standard types" of squirrel cage motors, gives representative characteristic curves, and lists the proper applications of each type.

Normal Torque Standard Squirrel Cage, Type No. 1

The standard squirrel cage motor is perhaps the most widely used type. It is suitable for a great variety of applications—group or individual drives, machine tools, fans and blowers, pumps and many other drives where normal torque is required.

With rated voltage applied at the terminals, standard four pole motors develop a minimum starting torque of 150 per cent of full load torque (Table I). The torque increases gradually until it reaches a maximum of from 250 to 300 per cent at about 75 per cent full load speed. At no load the speed is practically synchronous; as load is applied speed falls off uniformly up to full load, where it is approximately 95 per cent of synchronous speed. Since these motors operate at nearly constant speed from no load to full load, they are often referred to as "constant speed motors."

In sizes above 7½ hp. these motors draw starting currents at full voltage in excess of the National Electric Light Association's recommendations (Table II), and therefore require current-reducing starters.

Normal Torque, Across-the-Line, Type No. 2

A current-reducing starter is an expensive device, and so in order to eliminate the need for it the standard squirrel cage design has been modified. A second type of motor whose starting current is within the N.E.L.A. limits has been produced. For starting this motor a simple magnetic switch is used which has the required overload and undervoltage devices at a cost considerably less than the voltage-reducing starter. These motors are available in the normal-torque design up to and in-

cluding capacities of 30 horsepower.

In Fig. 1 are shown the speed-torque curves of these two types of motors. It will be seen that an across-the-line motor at full voltage gives 100 per cent more starting torque than a standard motor of the same hp. rating started with a current-reducing starter at 65 per cent normal voltage. In addition to the greater torque, the use of a magnetic switch with a push button permits cheap and simple automatic control, whereas equivalent control for the standard motor can be obtained only by the use of an expensive automatic starter.

Low Torque, Across-the-Line, Type No. 3

A third type of squirrel cage motor furnished in ratings above 30 hp. is designed especially for centrifugal pump service, and meets N.E.L.A. starting current recommendations up to 100 hp. Some starting torque is sacrificed to reduce the starting current, but this concession is not objectionable for use on centrifugal pumps. The starting torque of this motor is 80 to 100 per cent of full load torque.

TABLE I—MINIMUM STARTING TORQUES AT RATED VOLTAGE*

Poles (60 Cycles)	Torque, Per Cent of Full Load
2	150
4	150
6	135
8	125
10	120
12	115
14	110
16	105

*Adopted by the National Electrical Manufacturers' Association for standard, general-purpose squirrel cage motors.

High Torque, Double Squirrel Cage, Type No. 4

A fourth type of motor is available in sizes up to and including 30 hp. where high starting torque is required. Crushers, plunger pumps, air compressors, refrigerating machinery, and similar drives are best served by motors of this type. By the use of double squirrel cage rotors and special stator windings, from 200 to 250 per cent of full load torque is developed at start. Notwithstanding the higher starting torque, the starting current is within the N.E.L.A. limits shown in Table II, and the motors may therefore be started directly across the line. In Fig. 3 are shown typical speed-torque curves.

High-Torque, Double Squirrel Cage, No. 5

A modification of the across-the-

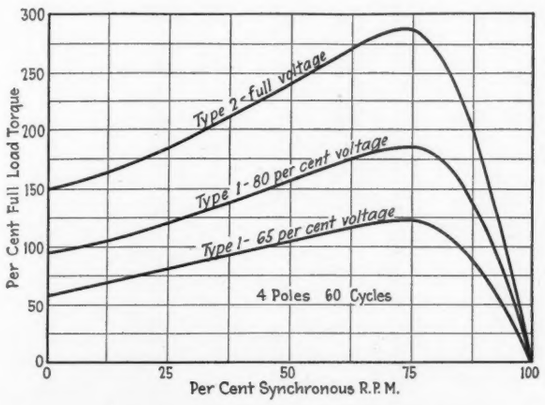


Fig. 1—Typical speed-torque curves of squirrel cage motors—standard and across-the-line type. At full voltage the latter type gives 100 per cent more starting torque than a standard motor of the same hp. rating started with a current-reducing starter at 65 per cent normal voltage.

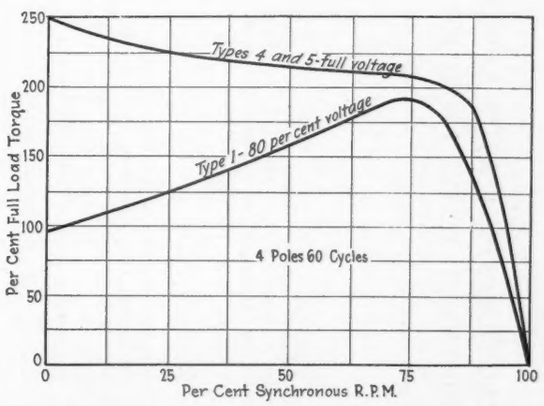


Fig. 3—Typical speed-torque curves of double squirrel cage and standard squirrel cage motors compared. By the use of double squirrel cage rotors and special stator windings, 200 to 250 per cent of full-load torque may be developed at start. Double squirrel cage types above 30 hp. require current-reducing starters.

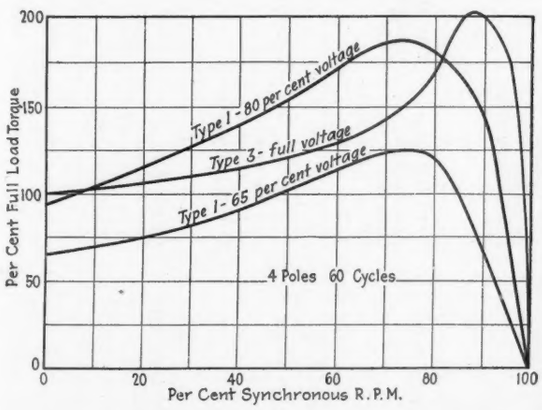


Fig. 2—Typical speed-torque curves of centrifugal pump and standard squirrel cage motors. The former are furnished in ratings above 30 hp. and meet N.E.L.A. starting current recommendations up to 100 horsepower.

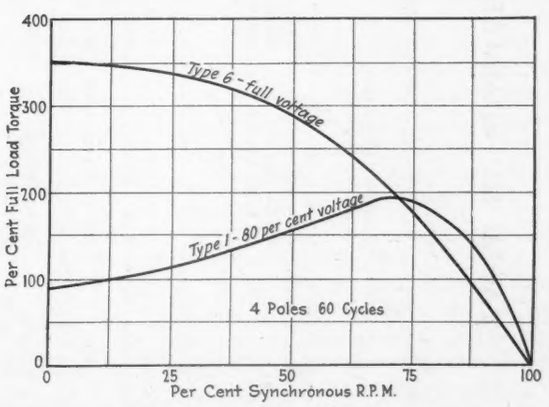


Fig. 4—Typical speed-torque curves of punch press type and standard squirrel cage motors. Punch press motors are designed for high starting torque and high slip. As a result, full-load speed is somewhat lower than that of standard motors.

TABLE III—SUMMARY OF CHARACTERISTICS AND APPLICATIONS OF SEVEN TYPES OF SQUIRREL CAGE MOTORS

Type	Standard Ratings (Single Speed)	Starting Current	Starting Torque*	Per Cent Full-load Slip	Typical Applications
1—Standard Squirrel Cage	1/10 hp. up 3 or 2 phase 25 to 60 cycles 110 to 2,200 volts	May not necessarily meet N.E.L.A. recommendations. Power companies ordinarily require current reducing devices on ratings of 7½ hp. and larger	Varies with the square of the voltage applied to the motor terminals: approximately 150% of full-load torque at rated voltage; 96% at 80% voltage; as low as 38% at 50% rated voltage	4 to 5	Group or individual drives on machine tools, fans and blowers, compressors, centrifugal pumps — on any application where normal-torque motors are satisfactory
2—Normal Torque Across-the-line	7½ to 30 hp. 3 or 2 phase 60 cycles 110 to 2,200 volts	Within N.E.L.A. starting current recommendations, hence within most power companies' limitations, and therefore suitable for starting directly across the line	Approximately same as for Type 1. As these motors can be started across the line at rated voltage, they can start at considerably more load than Type 1 motors started under reduced voltage	4 to 5	Same as those of standard squirrel cage motors
3—Low Torque Across-the-line	40 to 100 hp. 3 or 2 phase 60 cycles 220 to 2,200 volts	Same as for Type 2	Centrifugal pump service does not require heavy starting torque. Therefore these motors have starting torque of 80% to 100% of full-load torque	4 to 5	Centrifugal pumps, agitators, fans and blowers, generator sets, and other applications requiring low starting torque
4—High Torque Across-the-line	3 to 30 hp. 3 or 2 phase 60 cycles 110 to 2,200 volts	Same as for Type 2	About 200% to 250% of full-load torque	4 to 5	Crushers, plunger pumps, belt conveyors starting under load, large air compressors, large refrigerating machinery, mixers, and other applications requiring high starting torque
5—High Torque	40 to 100 hp. 3 or 2 phase 60 cycles 220 to 2,200 volts	Starting currents above most power companies' limitations; hence, current reducing starting devices ordinarily used	Varies with the square of the voltage applied to the motor terminals: approximately 200% to 250% of full-load torque at rated voltage; 130% to 160% at 80% voltage; 85% to 106% at 65% rated voltage	4 to 5	Where the torque produced by other motors is not sufficient. If the starting torque of Type 5 motors under reduced voltage is too low for any application, slipring motors should be used
6—Punch Press	1 to 150 hp. 3 or 2 phase 25 to 60 cycles 110 to 2,200 volts	Low enough to start across the line	About 350% of full-load torque	10 to 13	Punch presses, shears, bulldozers, metal-drawing operations, balers and other machinery equipped with flywheels or having flywheel effect
7—Elevator and Hoist	1 to 30 hp. 3 or 2 phase 25 to 60 cycles 110 to 550 volts	Lower than for any other type of squirrel cage motor. No current reducing starting devices used	About 250% of full-load torque	15 to 17	Elevators, cranes, hoists, dumbwaiters

*All percentages given are for 4 pole 60 cycle motors only.

line double squirrel cage motors described above is available in sizes from 40 to 100 hp. These motors do not meet N.E.L.A. starting-current recommendations, and therefore require current-reducing starters. Electrically and mechanically they are similar to the smaller horsepower ratings.

Punch Press, Type No. 6

An interesting type of motor is now available for use on punch presses, shears, bulldozers and other heavy inertia drives with fluctuating loads and heavy flywheels or flywheel effects.

The function of the flywheel is to store energy as the machine idles, and to deliver the stored energy during the punching, shearing, or other operation. In order to do this, the flywheel must be allowed to slow down during each operation, and must be accelerated quickly to full speed immediately thereafter to prepare it for the next operation. The proper motor for such a service is one which has high slip to allow the flywheel to release its stored energy, and high starting torque to overcome inertia of the heavy flywheel, so that the flywheel can be brought up to full speed quickly at the start and after each operation.

The standard constant-speed motor does not slow down sufficiently with an increase in load to allow a flywheel to deliver its stored energy, hence draws more current at each stroke of the machine, causes greater line disturbances, and uses more power than a punch press motor. The punch press motor has the ability to slow down as the load increases. Because of its high torque it brings the flywheel back to full speed quickly after the stroke. The high starting torque (35 per cent) and high slip permit the use of a smaller motor than would ordinarily be required, with consequent savings in first cost as well as in maintenance.

Figure 4 shows a typical punch press motor speed-torque curve, and a standard motor curve for comparison. The full load speed is somewhat lower than that of the standard motor because of the high starting torque design.

TABLE II—N.E.L.A. STARTING-CURRENT RECOMMENDATIONS
Amperes Per Phase (75 per cent of locked value), 60 Cycles

HP.	—220 Volt— 3-Ph.	2-Ph.	—440 Volt— 3-Ph.	2-Ph.	—550 Volt— 3-Ph.	2-Ph.	—2200 Volt— 3-Ph.	2-Ph.
7½	86	74	43	37	24	30	...	...
10	106	92	53	46	42	37	...	...
15	148	128	74	64	59	52	...	...
20	188	166	94	83	76	66	20	20
25	228	203	114	102	92	81	25	25
30	270	240	135	120	108	96	30	30
40	285	250	142	125	114	100	30	30
50	300	260	150	130	120	104	30	30
60	360	312	180	156	144	126	36	30
75	450	390	225	195	180	157.5	45	37.5
100	600	520	300	260	240	210	60	50

TABLE IV—COMPARATIVE MOTOR PRICES
In each size, the standard squirrel cage motor price is taken as base, or 100 per cent. All prices are for 440 volt, 60 cycle, 3-phase motors with starters.

Type	7½ hp. 1800 r.p.m.	10 hp. 1800 r.p.m.	15 hp. 1800 r.p.m.	20 hp. 1800 r.p.m.	25 hp. 1800 r.p.m.	30 hp. 1800 r.p.m.	40 hp. 1800 r.p.m.	50 hp. 1800 r.p.m.	100 hp. 1800 r.p.m.
	Per Cent								
1—Standard Squirrel Cage*	100	100	100	100	100	100	100	100	100
2—Normal Torque Across-the-line†	66	74	78	84	86	87	...	...	...
3—Low Torque Across-the-line†	...	...	...	...	...	...	94	95	100
4—High Torque Across-the-line†	72	80	85	88	93	95	...	...	...
5—High Torque*	...	...	...	...	...	...	112	112	110
5—High Torque†	...	...	...	...	...	...	98	100	104
6—Punch Press†	80	93	100	107	112	115	117	120	...
7—Elevator and Hoist†	72	75	76	96	106	133	...	...	...

* With voltage-reducing starter. † With across-the-line starter.

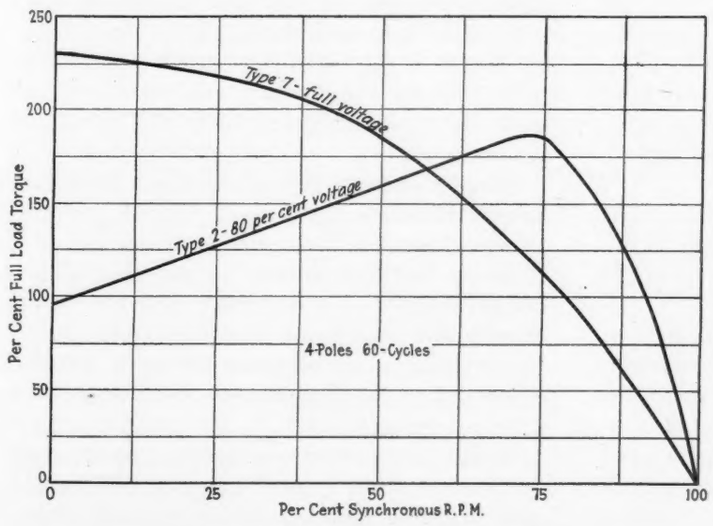


Fig. 5—Typical speed-torque curves of elevator type motors compared with those of squirrel cage motors. High starting torque, low starting current, and ability to withstand frequent starting, stopping, and reversing are required of elevator motors.

Elevator and Hoist, Type No. 7

Squirrel cage motors are used on elevators and hoists where speed control is not required and where the service is intermittent. High starting torque, low starting current, and frequent starting, stopping, and reversing are required. (See Fig. 5).

Multi-speed Motors

All seven types of motors can be supplied with windings of one, two, three, or four speeds. The multi-speed motors have characteristics at each speed similar to like-rated single-speed motors. Fans, blowers, dough mixers, pumps, lathes, and elevators are a few of the multi-speed motor applications.

MAINTENANCE ENGINEERING

L. C. MORROW, Editor

DECEMBER, 1931

Let's Look Again at Unemployment

ON THIS page last month we outlined the suggestion of James W. Hook concerning industry's responsibility toward "stable workers." Among many plans proposed it stands out as simple and practicable. Yet it is a "long time" plan rather than one designed to meet the immediate unemployment emergency.

The country (therefore industry) is faced with two problems: (1) caring for unemployed immediately; (2) what to do about stabilization of employment for all time, and how to do it.

It seems that present conditions have existed long enough that they have inspired many capable minds to work on the problem of stabilization. Unless a tidal wave of prosperity once more exerts a soporific effect we may expect to see presented some workable plans that eventually will lead to definite action or conclusions.

The more important problem now is the caring for unemployed immediately. The President's Organization on Unemployment Relief provides the requisite machinery, of which local sub-organizations are parts. Power input for the machinery must consist of dollars and jobs. Both can be furnished by both industrial plants and individuals.

Typical of what the industrial plant can do to furnish dollars is the action of the I-T-E Circuit Breaker Company in donating two per cent of its gross sales for November to March, inclusive, to the relief organization of the communities in which the sales originate.

An example of increasing jobs in the industrial plant is furnished by the Kellog Company in its change from three eight-hour to four six-hour shifts.

Not so spectacular, but greatly needed, and tremendous in their cumulative effect, are the dollars and jobs that individuals can add to the power input. The dollars they will add as such, as they do always in emergency. The jobs will be produced with more pain, because the man accustomed to make his own repairs around home, to take out his own ashes, shovel his own snow, and help with the family wash, is going to give up those pleasures with reluctance. In giving them up, however, lies his opportunity to "make work." It is the "made work" that is going to be of great importance this winter, to maintain the self respect of the recipient as well as to feed him and his dependents.

The individual can do more; he can enter into the relief activities of engineering societies and similar organizations. To illustrate the possibilities of such organization work: In New York City the committee of the engineering societies, cooperating with the sub-organization of the President's committee, has helped to place 2,000 men at work compiling a new city directory; about 500 at work in museums; others in the engineering departments of the city.

One can see signs of business improvement if he looks carefully. This winter's demands upon job holders probably are the last that will be made during this depression. Obviously we must see it through, hoping that enough light will be shed on economic problems to make a recurrence of such extensive sacrifice unnecessary.

■

Raising the Power Factor of the Maintenance Department Dollar

TIME for New Year's greetings is still some distance away, but it is not too soon to be thinking about improvements in handling the work of the maintenance department that can be put into effect at the beginning of next year.

For example, there is the question of budgetary control. In one form or another such control is in effect in a large number of plants. When properly applied, control of maintenance activities by budget offers many advantages. It permits farsighted planning of the most important kinds of work, and automatically leads to that close control which is the essence of good engineering and good business. Budgetary control merits careful study by every maintenance engineer who is not now using it.

Wage incentives for maintenance work likewise offer worthwhile advantages. Placing a premium on speed and skill creates a demand for these qualities that usually can be supplied with satisfaction both to the workmen and the employer. In more than one plant significant reductions in the cost of doing many kinds of work handled by the maintenance department have been made by wage incentive plans.

If for any reason the application of wage incentives does not appeal, more careful and intelligent planning and scheduling of work oftentimes can be made to show good economies. Going deeper into the subject, even a superficial analysis of the operations involved in the more important

activities of the maintenance department may point the way to increased efficiency and economy.

These are some of the ways—and there are others—in which the power factor, so to speak, of the dollars appropriated for maintenance work during 1932 can be brought as close as possible to unity.

■

Why Not a Five-Year Plan for Maintenance?

MUCH has been heard of late about five-year plans—plans for this, that and the other thing. Whatever may be our opinion about any specific plan, the idea of outlining things to be done during the next few years has much to commend it. Such plans necessarily presuppose a thorough analysis of conditions now existing, the delineation of certain desirable objectives, and the development of a schedule, and perhaps means for accomplishing them. If nothing concrete were achieved, the broader understanding that is certain to result from careful study of a situation and decision as to what changes are desirable would in most cases be worth all of the work involved.

Five-year plans, or those for any other period, should not be the exclusive property of the sales or production departments. There are plenty of projects which the maintenance department can undertake on the instalment basis, so to speak. To cite only two examples of those that come to mind, one large plant is gradually replacing all of the open wiring in its older buildings with conduit work, and is substituting new lighting units for the less efficient type now used. The maintenance budget each year carries an appropriation for these and other like jobs. Within a few years the plant will be thoroughly up to date and, although the cost of the work will be large, the payments are spread over so long a period that they are not burdensome.

In another plant it is planned to put every maintenance job that can be so handled on an incentive basis during the next five years.

Taking industrial plants by and large, there are plenty of old buildings that should be revamped, plenty of obsolete equipment that should be replaced, slipshod methods of handling work that must some day be brought into line with modern practice.

A comprehensive plan that requires some time for execution has, among others, the great advantages of providing a dependable reservoir of work, and permitting purchases of equipment and materials to be made whenever unusually favorable terms can be obtained.

Standard or Special?

STANDARDIZATION of equipment and materials may have its disadvantages, but it has enough good points to make it the order of the day. Certainly it tends toward lower prices for equipment, reduces the number and variety of spare parts that must be carried in stock, and simplifies maintenance work.

Co-incidental with the development of standardized lines there has been an increasing complexity of operating conditions and requirements that sometimes leads to real or fancied difficulty in the application of standard apparatus. This situation seems to be particularly marked in the case of control equipment. For one reason or another a considerable number of industrial customers frequently either feel that their requirements cannot be met by standard apparatus, or have a desire to prepare their own specifications that is overwhelming. In both cases the result is the same: One or more manufacturers are asked to bid on equipment that must be considered as special, even though the departures from standard lines may be comparatively slight.

Special orders usually mean extra bother and higher costs to the manufacturer, and delayed deliveries and higher prices to the customer. If the user were always really benefited thereby, no one would have cause for complaint; unfortunately, this is not the case.

There are, doubtless, conditions and requirements that demand the use of special control and other apparatus, which may be worth all it costs to buy and maintain. Nevertheless, as a rule, it is advisable to make every effort to use standard equipment whenever possible, unless it is definitely known that important advantages will result from doing otherwise.

■

One of Winter's Reminders

DARK days are upon us. Reference is to the season, not business conditions. Plants are being operated for longer periods with artificial illumination. Many engineers are bewailing their lack of foresight in passing by last summer's opportunity to revamp lighting equipment.

More inconvenient now, but not impossible, to change lighting. Should be done, of course, and the added cost written off at once.

Perversity prevailing, so far as immediate action is concerned, the dark days should serve at least as a jog toward definite planning of the better lighting system to be installed when long, light days have returned.

With us it isn't a case of "We told you so," but "Let us remind you again."

What You Should Know About Lamps

ROY A. PALMER
Illuminating Engineer, Southern Public Utilities Company
Charlotte, N. C.

DID YOU Know That—Less light is obtained from three lamps than from one of the equivalent wattage? Long-life as against short-life lamps produce less light per watt of energy consumed? There is a fluctuation in the rate of burnouts of original and renewed lamps?

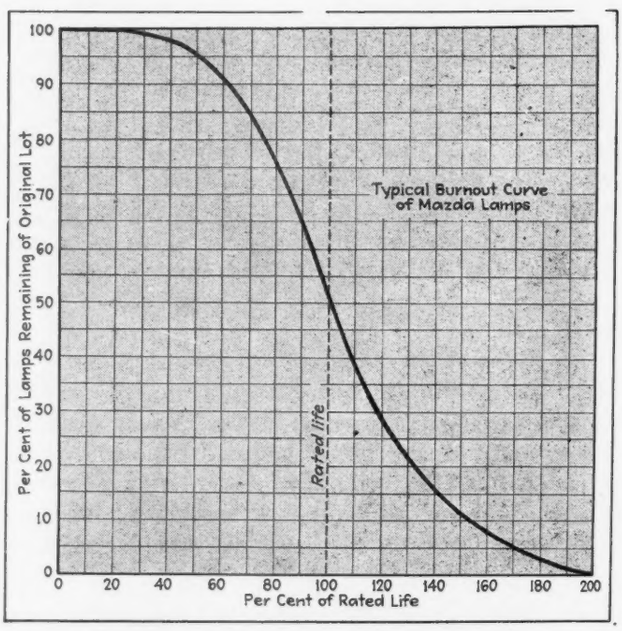


Fig. 1—Early burnout may result from several causes. Test data, plotted as shown, refers to Mazda lamps in lots.

DUE TO the experience of a considerable number of plants in securing increased production, less spoilage, lower labor turnover, and fewer accidents through the installation of modern lighting systems, artificial lighting has been placed upon the same basis as automatic machinery, materials handling equipment, and other modern tools.

As a result proper maintenance of the lighting system becomes of paramount importance. The incandescent lamp is the heart of the system and, with the increasing use of modern lighting methods, questions regarding lamps and their performance come up with greater frequency.

Many improvements and developments in incandescent lamps have brought about changes in their characteristics and performance. It follows, therefore, that opinions regarding lamps may be obsolete or entirely wrong. A few pointers will be helpful in securing greater economy and better results from this very important production tool.

Principles of Operation—If an iron poker is shoved into the hot coals of a fire and left there for a short while, it will exhibit a dull red heat when withdrawn. In a dark room the hot poker will produce a very low level of illumination in the immediate area. If the poker is heated until it is white hot it will produce a higher level of illumination.

Similar to the foregoing is the principle of operation of the incandescent lamp. The tungsten filament is heated to incandescence and, being inclosed in a glass bulb from which all oxygen is exhausted, it is not destroyed. Continual heating of the poker would soon consume the iron. The lamp filament, if burned in the air, also would be consumed in a few seconds because of its smaller diameter and its affinity to combine with oxygen.

Gas-Filled Lamps—Even in the evacuated bulb the tungsten filament disintegrates or evaporates when burned. Previous to 1913 the filaments of all lamps operated in a vacuum, but rapid evaporation prevented operation at relatively high temperatures. The introduction of an inert gas into the bulb retarded the rate of evaporation, thus permitting filament operation at increased temperature. In this way more light is produced today with no greater current consumption. Argon with a small percentage of nitrogen is used.

All lamps of 50-watt rating and above are gas filled. There is no advantage in its use in the smaller sizes, because of the small filament surface exposed. The heat from the filament is carried away so rapidly as

to offset the advantage gained in the use of gas in larger lamps.

Light Produced—As the filament evaporates, fine particles of tungsten are deposited on the inside of the bulb, which darkens the glass and absorbs some of the light. In gas filled lamps the gas conducts the particles to the top of the bulb. The continual evaporation of the filament gradually decreases its diameter; less current is consumed, decreasing the temperature and consequently producing less light.

In gas-filled lamps the filament is wound in coils. If these coils should become distended, the gas would conduct the heat away from the filament so rapidly that the temperature would be reduced and the light output decreased. Throughout the life of the lamp these various factors may reduce the light output as much as 20 per cent.

Lamp Life—Purchasing agents and plant executives generally gage the quality of a lamp by the length of its life alone. Long-life lamps are assumed to be better than short-life lamps. Actually, lamps may be designed to have a long or short average life as desired.

Lamps designed for a long average life will produce less light per watt of current consumed. The cost of current for a given amount of light will therefore be high and the lamp cost will be relatively low. Lamps designed for a short average life will produce more light per unit of current, thus lowering the cost of energy for a given amount of light, but increasing the lamp renewal cost. The most economical life is the point where the most light is produced at a minimum cost of current and lamps.

The life of standard lamps generally used in factories, homes, and stores is 1,000 hr. Where the cost of current is low it is more economical to operate lamps at a few volts over their rating for, contrary to general opinion, the cost of light then is less than when lamps average a long life.

Lamps are somewhat like human beings. No one can predict how long a certain individual will live, but insurance companies can give statistics with uncanny accuracy concerning the life span of a group of individuals. Likewise it is impossible to tell how long a single lamp will survive, but the average period of a group of lamps will be very close to their designed life. Of a group of lamps, some may last as long as 200 hr., others 400 hr., while some may burn as long as 2,000 hr. A typical curve showing the burnout rate of lamps by lot is shown on the preceding page.

Early burnout may result from several causes. When traced to an excessive rise in line voltage, the quality of the lamps should not be criticized for they cannot be expected to perform normally when operated considerably above their rated voltage.

If a filament is thinner at one point than the standard diameter for a given lamp size, this spot will operate at a considerably hotter temperature than the balance of the filament with the result that it will function a relatively short time. For this reason lamp filaments are manufactured with extreme precision with regard to uniformity of diameter. In the more common sizes of lamps this uniformity has been developed to a high degree thereby minimizing the number of early failures.

Renewal Rate Fluctuation—Maintenance men in plants experience intervals when lamp burnouts seem to occur with greater frequency. This condition may be due to excessive voltage or to short-life lamps but it is more likely due to fluctuations in the rate of burnouts of original and renewed lamps. Lamps of an original installation will burn out according to the typical mortality curve of Fig. 1. As the lamps burn out, others are substituted, among which a long-life lamp probably replaces one whose life was short. This lamp may therefore last longer than lamps which are placed in operation at a later date.

It is to be noted that the rate of renewals of the original installation is above normal after the rated life of the lamps is passed, but it falls again as the replacement lamps are in operation. See Fig. 2. The rated life of the replacement lamps approaches and causes another rise in the rate of renewals, but this rise is not as great as with the original lamps because they were placed in operation at different intervals. As time goes on this fluctuation is repeated but each rise and fall in the rate of renewals become smaller and smaller.

Often an increase in renewals is due to the increased hours of operation either because of greater night activity, an excessive number of cloudy days, or the approach of early darkness in the fall.

To avoid excessive lamp burnouts, lighting circuits should be segregated from power circuits so that the operation of heavy-duty apparatus will not cause a fluctuation in the voltage. Lighting circuits should have the benefit of regulated voltage, and the voltage rating of the lamps should be exactly the same as the voltage of the line.

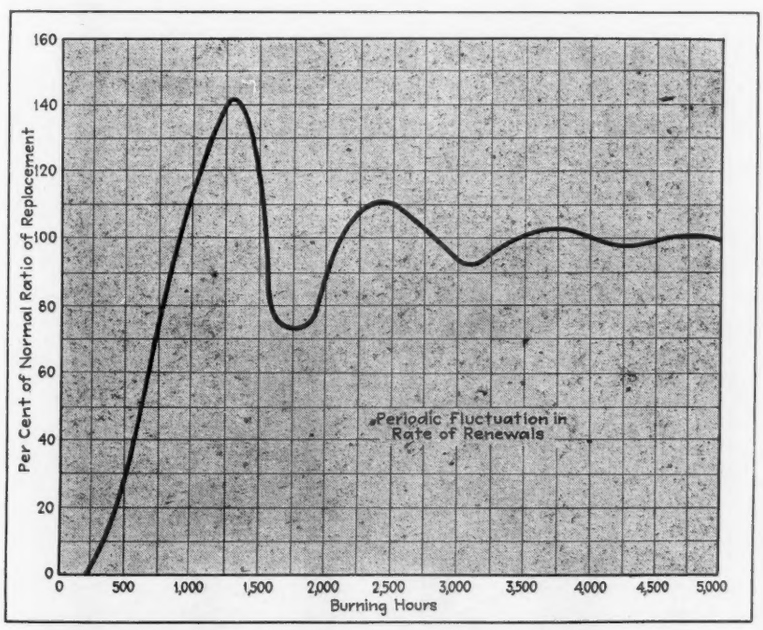


Fig. 2—Curve showing study of renewal rate of lamps in an original installation. The renewal rate is above normal as lamps exceed rated life.

Inadequate Wiring—Many plants are paying a premium for illumination because of inadequate wiring. Very often the substitution of larger lamps for smaller lamps has caused circuits to be overloaded, thereby increasing the voltage drop and reducing the light output of the lamps.

Long runs from the panel box to the outlets with undersize wire are also responsible for excessive drop in voltage. The code specifies minimum wire size from the standpoint of fire hazard, but it does not take into consideration voltage drop which has the same effect as using lamps of a lower voltage rating than that of the line. As mentioned previously, this condition lowers lamp renewal costs, but it also raises the cost of current for a given amount of light, which is made up largely of current and lamp cost. It follows that when the lamp renewal cost is low because of decreased voltage, the cost of light will be high, and the greater the difference between lamp and line voltage, as shown by the difference in the slopes of the curves in Fig. 3, the greater the increase in the cost of light.

Lamp Efficiency—Since light output is rated in lumens the efficiency of a lamp is lumens per watt of electricity consumed. Inasmuch as gas-filled lamps are more efficient than plain vacuum lamps, and large size lamps are more efficient than those of smaller capacities, it is often possible to increase the illumination in a plant without increasing the current consumption by replacing a number of small lamps with fewer lamps of the equivalent wattage, properly spaced and mounted, and equipped with good reflecting equipment. The graphical illustration in Fig. 4 shows how one 300-watt lamp gives practically as much light as four 100-watt lamps.

Inside-Frosted Lamps—When the inside-frosted lamps were introduced a few years ago considerable objection was raised against them on the supposition that the frosting reduced the light output. The fact is that very little light is absorbed by the frosting.

Many users judge volume of light by brightness and because the inside frosting reduced the brightness, the inference was that the light output was reduced. The brightness of the filament of a 10-watt, clear-bulb lamp may be several hundred times that of an inside-frosted bulb of a 25-watt lamp, but the light output of the latter is considerably higher. The value of reducing the brightness of lamps by frosting the bulb is obvious.

When bulbs are frosted on the outside, a considerable amount of light *is* absorbed. The light from the filament passes through the glass to the frosting on the outside where some of the light is diffused by it. The balance of the light is reflected back inside the bulb to the glass on the opposite side of the bulb where the same action is repeated. Each time the light passes through the glass some of it is absorbed. When the bulb is frosted on the inside, the light is not forced to pass through the glass when reflected back and forth on the inside of the bulb, consequently less light is absorbed.

Light absorbed by inside frosting is approximately two per cent of that in a clear bulb. This amount is so small as to be negligible, but even if it were of consequence, the better diffusion of light would warrant the sacrifice in light.

Inside frosting permitted the elimination of a large variety of lamps such as bowl-frosted and all-frosted in each of the various wattages and shapes. Since the light emitted by the inside-frosted lamp is of higher quality than that from a clear-bulb lamp, it was deemed expedient to eliminate clear bulbs in the smaller-wattage lamps. This standardization of types of lamps in sizes up to and including the 100-watt lamps reduced production costs, which, in turn, lowered lamp costs.

Heating Effect—The incandescent lamp is the safest illuminant that has

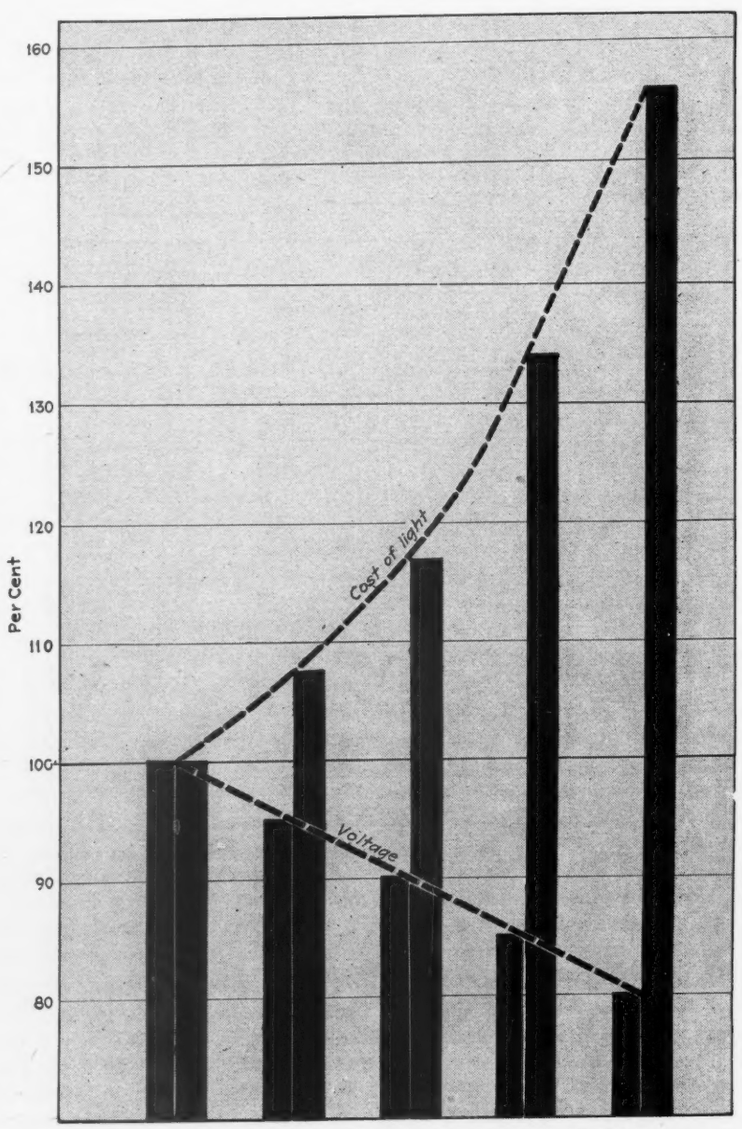


Fig. 3—Illustrating the fluctuations in the cost of light as compared to the voltage of the circuit.

yet been devised. However, there are locations where some precautions may be necessary owing to the heat emitted or from accidental breakage in gaseous locations.

In plants such as flour mills and grain elevators, where there is considerable dust, a hazard is present if a source of ignition is at hand. The accidental breakage of an incandescent bulb may provide a source of ignition and, if the proper mixture of air and dust are present, an explosion may result.

Use of lamps on drop cords should be avoided in such locations. The illumination should be supplied by a general system of lighting wherein the lamps will be out of reach and not ordinarily subject to breakage. The use of inclosing units will serve to protect the bulb, but where inflammable gas or low ignition dusts are present, vapor-proof units should be used.

Considerable comment is often heard among maintenance men regarding the effect of ventilation on the life of lamps. It is natural to suspect that a non-ventilated unit will increase the temperature and possibly affect the lamp, but when one considers that the operating temperature of the tungsten filament is in the neighborhood of 2,527 deg. C., and the melting point, 3,382 deg. C., the addition of 100 deg. or more is not going to have any appreciable effect on the filament.

Research laboratories have made many careful tests to ascertain the effect of operating lamps in inclosed units. From the lighting standpoint, there is considerable advantage in completely inclosed units since they can be made dust and insect proof, as well as moisture proof for outdoor or damp locations.

Another application of incandescent lamps wherein heat is a factor is in refrigerator rooms or cases. The amount of heat given off by a lamp is relatively small so that it is not an item of concern from the standpoint of refrigeration. Although the heat in the area immediately surrounding a lamp is sufficient to damage meats, it should be located and protected so as not to come in close proximity to material in storage.

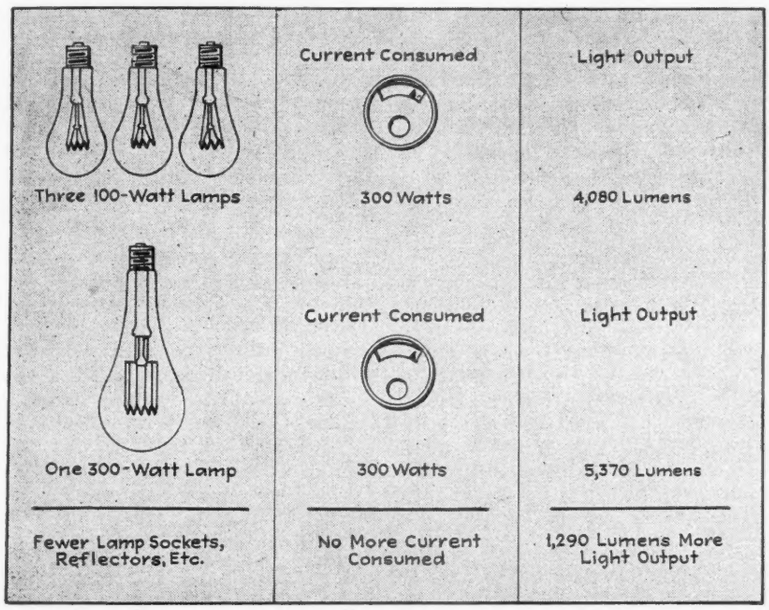


Fig. 4—Comparison of light output between lamps of equivalent wattage.

Selecting Lamps—The selection of the right lamp for a particular purpose is important if the most economical and best service is desired. Probably the most frequent misuse of lamps is in the standard RLM dome reflector.

This reflector was designed for high efficiency, good distribution, and ample protection from glare. The reflecting surface and contour assure efficiency and good distribution while the apron provides a partial shield to protect the eyes from the brightness of the lamp. When clear lamps are used in these reflectors, mounted 20 ft. or less from the floor, the glare from the bright filament is annoying and harmful. To avoid this condition *white-bowl lamps should always be used* in RLM domes at low mounting heights.

In many cases vibration is so severe and extensive as to effect lamp life. For such locations there are available mill type lamps in which the filament is mounted and supported so that it can withstand high-frequency vibration. It is available only in the 50 watt size, higher in cost and less efficient than the 50 watt, inside-frosted lamp. For these reasons it is not economical to employ this lamp in places other than where vibration is present and of sufficient force to warrant its use.

The rough service lamp is designed for application wherein the lamp will be subject to bumps or jars rather than vibrations. This lamp is also rated at 50 watts, but it is one in which the filament is rigidly supported so that it will keep its normal position under the strain of bumps. It will not withstand vibration and should not be used as a substitute for the mill type lamp.

Daylight lamps may be used to advantage in industries where colors are to be observed. These lamps have a blue-green glass bulb which absorbs some of the red and yellow rays of the light thus producing a light of whiter quality than that of the ordinary clear-bulb lamps. For accurate color matching these lamps will not provide the proper spectral quality of light. High wattage clear lamps with special globes to absorb a greater amount of the red and yellow rays than the bulb of the Daylight lamp should be used to produce the whiter light required for this purpose.

■

New Uses for Photoelectric Cells

RESULTS of a great amount of experimental work are constantly becoming apparent in the new applications that are being found for electron tubes in industry. For example, a manufacturer of butter cartons who formerly sold his product by weight now uses a photocell to count the containers, and saves 10 per cent.

Brown or discolored navy beans will henceforth be separated from their white companions by sorting machines. As the beans pass in parade before a photocell, the undesirables are deftly flicked into oblivion by a metal finger actuated by the photocell through a relay. Plans have been made to install 200 bean sorters capable of handling a carload of beans a day.

AROUND the WORKS

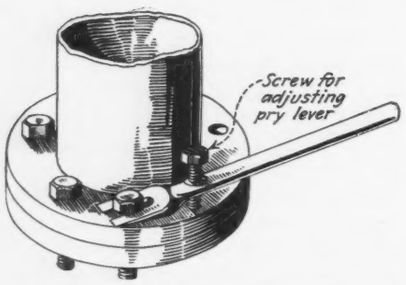
A section devoted to short articles describing practical methods devised to meet specific operating conditions. The items may refer to details of installation, inspection and testing for maintenance, wiring, repair, and replacement.

◆

Bolt Pry Bar Prevents Damage to Threads

REMOVAL of bolts from pipe flanges or machinery parts without injuring the threaded ends can be accomplished with the steel pry bar shown in the accompanying sketch.

The principal feature of its design is the adjustable toe or pry bolt which



When using the pry bar insert the claw under the bolt head and take up the slack with the screw. Repeat until the bolt is extracted.

enables the operator to obtain the desired leverage in extracting the bolts.

Little difficulty will be encountered in making a tool of this kind and it will be found useful for many jobs.

CHAS. H. WILLEY.
West Concord, N. H.

■

Rebuilding of a Fan Unit as an Example in Cutting Maintenance Costs

WE HAVE in our plant approximately twenty exhaust fans. They are used for circulating air in dryers and for exhausting spray-painting fumes. The motor for driving each fan is supported on the cast-iron framework of the unit and drives the impeller through a 1-in. flat leather belt. The cost of a unit when new was approximately $50. Rebuilding added approximately $18 to this figure.

These fans as originally purchased were equipped with bronze bearings, which gave from three weeks' to one year's continuous service. Such a short life was caused by poor lubrication of the bearings, which received oil through the hollow shaft of each fan as shown in Fig. 1. The grease cup was screwed into the frame at *A*, and the grease was supposed to lubricate both bearings from the one end of the shaft. But, if one bearing had a slightly closer fit than the other, all of the grease would go through one bearing, and none into the other. With a bearing once dry it would be only a short time until the fan was shaking itself to pieces. The thrust on the bearings, against which the thin fiber washer at *C* was the only provision, also caused considerable trouble.

In Fig. 1 the original unit is shown with bronze bearings and a hollow shaft. The removable plate *B* was discarded entirely, and the end *A* sawed off to about $\frac{1}{16}$ in. from the main part of the casting. As we had no boring mill or lathe large enough to handle the unit to machine the sawed end, the unit was clamped on a block on the drill-press table with the finished face down to enable us to increase the bore in the sawed end from $\frac{3}{4}$ in. to 1 in. in outside diameter. This enlargement was made to give strength to the bearing holder *D* which was to be pressed in. An old 1-in. drill was ground down on the end to act as a pilot and the hole drilled out to 1 in. diameter. The pilot on the 1-in. drill made it follow the old hole exactly. A counter bore was then used to spot-face the sawed end. The steel plates *D* and *E* were then turned on a lathe. The end *H* on the piece *D* aligns the bearing with the bearing in holder *E*.

Small grooves on each side of the self-aligning ball bearings act as seals to keep out dirt. The cap screw and washer *J* take the thrust. Most radial ball bearings will take a side thrust equal to 50 per cent of the radial load. Fittings are connected to each bearing by means of drilled holes. Plate *F* is a cover for the back bearing. Plate *G* is a cover for the front bearing and contains a felt ring to keep out foreign material. A new shaft was necessary because the old shaft was $\frac{1}{2}$ in. in diameter, and the bearings required a 0.59-in. diameter shaft.

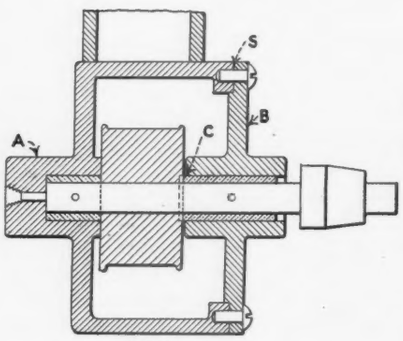


Fig.1

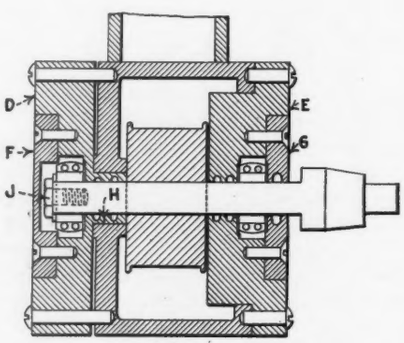


Fig.2

Rebuilding a number of fan-drive units from the bronze-bearing type shown in Fig. 1 to the ball-bearing type shown in Fig. 2 reduced lubrication and power costs.

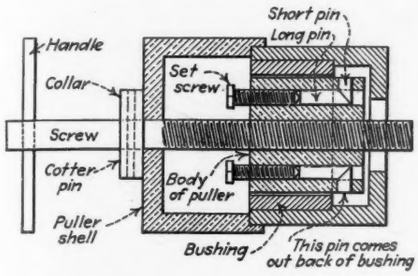
The rebuilt units have been in operation for over two years. They give no trouble whatsoever, and must be greased no oftener than every three months, whereas the old units had to be greased every day. J. CONRAD WATSON.

Franklin Pottery
Lansdale, Pa.

Pin- and Screw-Type Puller Speeds Up Bushing Removal

CONSIDERABLE difficulty was experienced in replacing several hundred bushings in as many hub assemblies until the puller outlined in the accompanying sketch was designed.

We placed the body of the puller in the bushing, with the set-screws free. The long pins were backed up against the set-screws, which permitted the



Beveled pins, equally spaced on the circumference, lock the puller behind the bushing. Removing the bushing from the hub is done by turning the screw handle.

short pins to drop in place, flush with the outside of the puller body.

With the body of the puller in place, as illustrated, the four set-screws were tightened to force the long pins against short pins, causing them to lodge behind the bushing. This movement is caused by the bevel on the pins.

The next operation was to screw the shell and screw assembly in place by running the screw through the hole in the body of the puller which is tapped to fit the thread on the screw. The handle on the end of the screw was turned until the bushing was removed.

When a large number of bushings must be removed, a puller of this type will be found satisfactory. The complete assembly is made of steel. Set-screws and pins should be hardened.

Only enough pressure should be applied to the set-screws to allow the flat end of the short pins to touch the inside of the shell behind the bushing, otherwise the pins will cut the shell.

Denver, Colo. R. M. THOMAS.

■

Soap Chips Facilitate Pulling Wire Through Conduit

WHEN renewing or installing wiring in conduit more or less trouble frequently accompanies the pulling-in operation. Grease applied to lead-sheath cables to ease this operation is not so effective at best, and any moisture present neutralizes the effect of soapstone. In many instances conduit runs have had to be cut and pull or junction boxes inserted after an unsuccessful effort has been made to draw in wires.

The use of soap chips or flakes will make pulling-in easy in cases where the operation would require the use of block and tackle, the insertion of boxes, or other laborious procedure.

The degree of success obtained by this method depends upon the amount of moisture applied to the chips or flakes. For the best results just enough moisture should be applied so that the chips will feel slippery, yet will not cake, dissolve, or lose their original form.

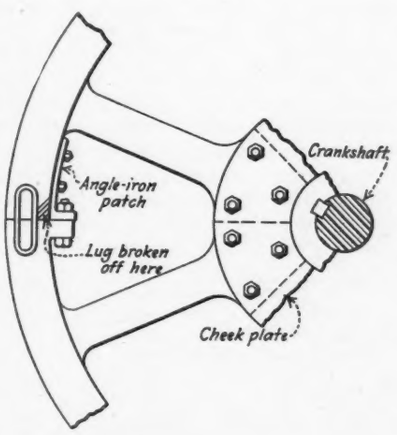
Louisville, Ky. J. R. ESTES.

■

Safe Repair of a Broken Flywheel

A SLIDE-VALVE engine of the box-bed type suffered much rough handling in the course of its long life of dismantlings and changes of location. One of the items of damage thus sustained was the breakage of the clamping lug on one of the rim segments of the flywheel.

The engine finally was installed in a rolling mill to drive the muck rolls. The speed required was about 60 r.p.m. It was figured that, running at this speed, the flywheel would operate safely with a patched rim. The wheel was 20 ft. in diameter, with a rim 9 in. wide and 12 in. deep. The rim was made in eight segments, each being cast integral with a single spoke. The eight spokes were secured by clamping them between circular cheek plates shrunk on a solid hub. Three clamping bolts, distributed in triangular formation, held each spoke end. The rim segments were fastened together with wrought-iron links shrunk in recesses on opposite sides, and with a single bolt through



each pair of clamping lugs. These details are shown in the accompanying sketch.

To replace the missing lug an angle piece, forged from a bar of 2 x 6-in. wrought iron, was fastened with two 1¼-in. studs to the inner periphery of the broken rim segment. With the engine running at the speed limit allowed, it was computed that the centrifugal pull on each rim joint was close to 27,000 lb. The patched joint was figured to be amply strong against this pull. J. A. DENNY.

St. Louis, Mo.

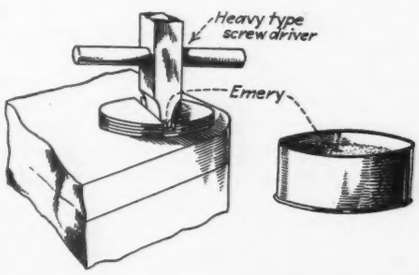
■

Emery Dust Holds Screwdriver in Slot

AN IDEA worthy of trial is illustrated by means of the accompanying sketch. It shows a heavy type screwdriver which is used for slotted cap screws.

Considerable danger attends the use of this tool, about which much emphasis has been placed, particularly on grinding the point to prevent its slipping from the slot.

It was observed in one large shop that dry powdered emery in a can was



With emery dust as a binder, considerable pressure can be applied to the screwdriver without having it slip out of the slot.

used as a dip for the screwdriver point. Using the tool with a bar, as shown, it was possible to tighten the cap screw without the screwdriver slipping from the slot. G. A. LUERS.

Washington, D. C.

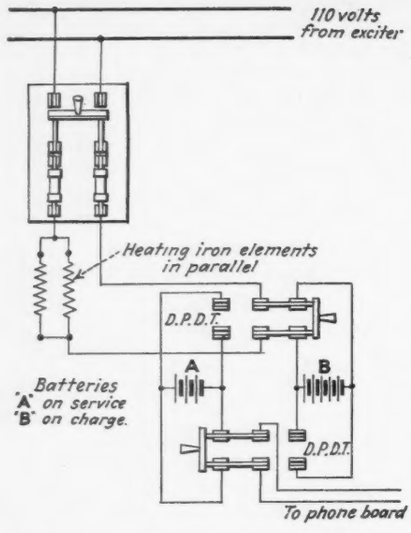
■

Emergency Charger Kept Phones in Service

AN INDUSTRIAL plant in an isolated community operated a private telephone exchange of the central energy type. The storage batteries were charged by means of a Tungar charger, using 110-volt, 60-cycle current.

Usually spare bulbs were kept in stock, but on one occasion, either through oversight in keeping up the stock or through breaking several bulbs in rapid succession, a burned out bulb could not be replaced.

To keep the plant in operation, quick action was needed. Several schemes were suggested but proved impractical. The difficulty was solved by removing the heating element from two, 600-



Heating elements from electric irons were used to replace a Tungar unit in charging storage batteries.

watt electric irons and placing them as shown in the sketch, using 110-volt d.c. from an exciter which operated about 20 hr. a day. This makeshift operated satisfactorily until a supply of Tungar bulbs was obtained. The telephones were kept in service without interruption. CHAS. A. PETERSON.
Mishawaka, Ind.

■

Typical Costs of Concrete for Small Jobs

THE COST of concrete used in plant construction jobs varies considerably according to such factors as accessibility and the nature of the form work. It is the intention in this article to give some costs of concrete work typical of the average plant. Although these figures are not applicable to large and involved construction work running into several hundred yards of concrete, such as large buildings and bridges, they will prove accurate enough for ordinary work around the plant.

Let us first consider a concrete block 10 ft. wide, 10 ft. long, and 5 ft. deep, neglecting the cost of excavation. Assume a simple form around the perimeter only in order to cut form work to a minimum. Using a 1:2½:5 mix, the cost of material required per cu.yd. of concrete will be as follows:

4.84 bags of cement at $0.60 per bag	$2.90
0.46 cu.yd. of sand at $1.40 per cu.yd.	0.64
0.92 cu.yd. of gravel at $2.11 per cu.yd.	1.94
	$5.48

Assuming that a one-sack machine is used, it will require four batches to make a yard of concrete. We can allow therefore about 20 min. for the four batches, or 1 cu.yd. Then the labor necessary per cu.yd. will be as follows:

1 carpenter (working boss) at $0.95 per hr.	$0.32
1 mixer man at $0.75 per hr.	0.25
4 laborers at $0.60 per hr.	0.80
	$1.37

Considering the form lumber next, the concrete block previously described will need about 500 b.ft. of lumber surfaced on one side and costing $25 per 1,000 b.ft., making a material cost of $12.50. The labor on the form including fairing up and setting foundation bolts will be $6, giving a total cost of forms of $18.50. As there are 18½ cu.yd. in the block, the cost will be about $1 per cu.yd. for form work. Assuming that there are 100 lb. of reinforcing steel necessary per yd. at $0.03 per pound, the total cost per yd. of concrete for block work can be obtained as follows:

Material	5.48
Labor	1.37
Steel	0.30
Form labor and material	1.00
Per cu.yd.	$8.15

The prices on labor and material are based on the prevailing market in Southern Calif. Of course substitutions will have to be made to suit other conditions.

In arriving at the cost of concrete work where there is a greater percentage of form work let us assume a wall 12 in. thick and formed on both sides. For this thickness 1 cu.yd. of concrete will be used on a wall 3 ft. high and 9 ft. long. For the form work there will be 54 sq.ft. of contact. From experience the cost of form work, labor and material, has been found to run about $0.10 per contact ft., making a total of $5.40 for 1 cu.yd. of concrete in place in the above case. Using the same mix as before but increasing the labor costs because of the necessity for elevating the concrete and extra work in spading, tamping, and setting the reinforcing steel, the following results are obtained:

Material	$5.48
Labor	2.10
Steel (assume)	0.50
Form labor and material	5.40
Per cu.yd.	$13.48

This figure is a minimum. It does not take into consideration any finishing or polishing operations. Where a larger mixer is used the cost will come down somewhat and, in mass work, the cost per cu.yd. will vary inversely as the volume of concrete is increased.

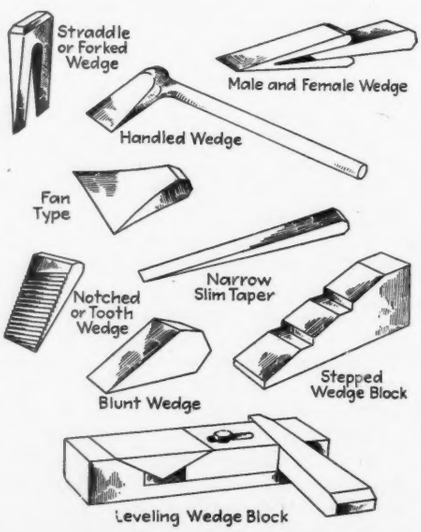
When measuring the quantities of material it is a good plan to make a cu.-ft. box with no bottom, set it in a wheelbarrow, fill it up, and then remove the box. The material next is levelled off and the side of the barrow scratched or marked to show the height to which it must be filled. The level of concrete should be checked from time to time because the gravel man often is found to skimp his load.
Arcadia, Calif. M. C. COCKSHOTT.

■

Metal Wedges Reduce Effort In Odd Maintenance Work

IN THE outfit of maintenance tools there should be afull assortment of steel wedges because of the variety of uses to which they can be subjected. Our experience has been that there are but a few plain wedges obtainable on the market, so it was necessary for our shop force to make its own.

By the means of the accompanying sketches, the different types of wedges that the men have found very useful on various jobs are shown.



The forked wedge is used in straddling bolts in the separation of flanged joints, etc. The male and female wedge is used in getting wedging action in a limited space. The stepped wedge is to permit gradual changes in elevations without the danger of slipping. Another non-slip wedge is the notched or tooth wedge. The leveling wedge block excels in setting up machinery. Sometimes it is operated by means of a screw, but for heavy work a sledge blow on the operating wedge is more effective than the operation of the screw type. The uses of the other types of plain wedges are apparent.

CHAS H. WILLEY.
Superintendent of Manufacturing
Hoyt Electrical Works
Concord, N. H.

Power Losses In Group Drives

Sources of friction and other power losses in group drives were discussed in two preceding articles, in the October and November issues. In this article, the third, the value of the results obtained by friction load tests is considered

ROBERT W. DRAKE
Mechanical and Electrical Engineer
Chicago, Ill.

A FRICTION test on a group drive ordinarily consists of measuring power input to the group shaft with the machines shut down, and then deducting the losses in the motor. This method lacks precision, but the comparative results are valuable. It is the only convenient method of shop testing.

At first thought it seems reasonable that the friction in lineshaft bearings should be far greater when the machines are loaded, but a careful analysis leads to the surprising conclusion that no-load friction tests as ordinarily run give a remarkably close indication of the true friction losses under full load operating conditions.

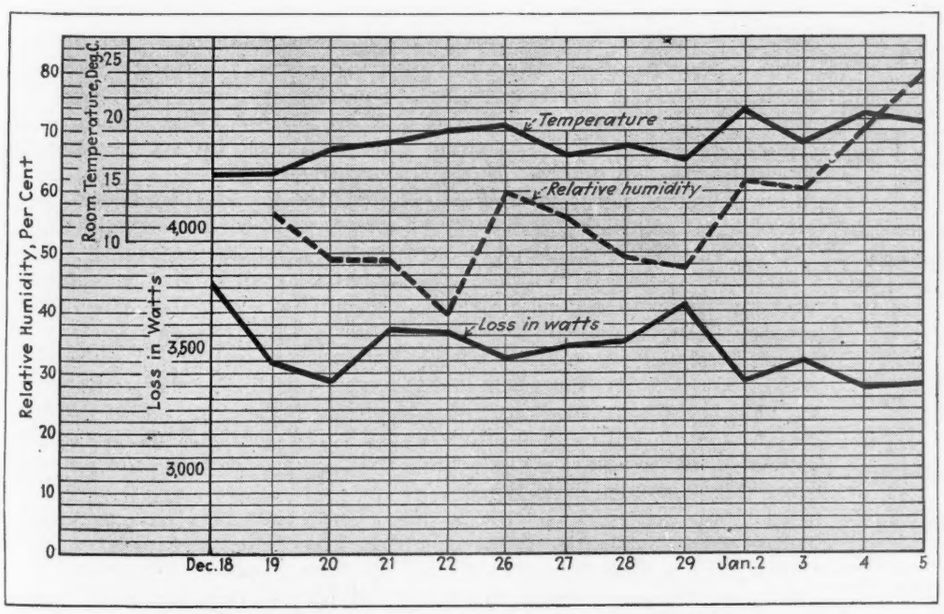
Let us consider the principal items separately. They are: (1) Lineshaft bearing friction. (2) Countershaft bearing friction. (3) Belt windage. (4) Pulley windage. (5) Creep and slip. (6) Unaccounted-for losses.

Lineshaft Bearing Friction—So long as lubrication, temperature, and the like, remain the same, the friction in a lineshaft or countershaft bearing increases with increased bearing pressure—not exactly in proportion to the pressure, but roughly so. The pressure of the shaft against the bearing consists of the resultant of the weights of the shafting, pulleys, and so on, and the pull of the belts.

Both the upper and lower strands of a belt leading away from the pulley must be resisted by the bearing pressure. In a belt without load, the tension of the upper and lower strands is equal. As the load increases the tension in one strand (the tight side) increases and the tight side stretches; stretching slacks off the belt on the loose side, and the tension on the slack side decreases. If the load is increased beyond the capacity of the belt with a given initial tension, gross slipping occurs.

For many years it was believed that the sum of the tensions of the tight and loose sides of a belt is constant, regardless of the load. If this were strictly true, the total friction on all bearings supporting any shaft, once the belts were put on under tension, would be unaffected by the amount of power transmitted. Lewis and Bancroft* discovered that the sum of the tensions on the tight and loose sides of the belt does not remain exactly constant, although the variation under load is small.

With the exception of Jones's recent work at Cornell, Barth's† analysis of belting theory is as close to the known experimental facts as any with which I am familiar. Jones has not published data on this particular matter. Using Barth's theory I have computed the increase in the total of tight- and slack-side tensions under six conditions covering the extreme range of ordinary applications (Table I), with the corresponding increase in bearing friction with load for ring-oiled, babbitt, spiral roller, and ball bearing hangers, at 200 r.p.m. The results will differ but little at other speeds. The average increase in friction



How lineshaft group losses, as determined by usual friction-load tests, vary from day to day with the relative humidity.

with load is seen to be 5½ per cent. This is really high, for I have neglected the fact that the bearing load is affected to a considerable extent by the weight of the shaft, which does not vary with the load. Perhaps 3½ per cent would be nearer the truth.

Countershaft Bearing Friction—Friction in countershaft bearings may be expected to increase somewhat more than 3½ per cent, for it is subject to the same factors as that of lineshaft bearings. During a test there are more countershaft belts on loose pulleys than during ordinary operation. Unless these pulleys have ball bearings they show, in general, somewhat higher friction losses than countershaft hanger bearings. When loose pulleys have inadequately lubricated sleeve bearings during a test, as friction of the countershaft bearings during a test, as compared with ordinary operating conditions, will be from 3½ to 7, or even 15 per cent.

TABLE I — INCREASE IN TOTAL BELT TENSION (SLACK SIDE PLUS TIGHT SIDE) WITH INCREASING LOAD

Velocity of Belt in Ft. Per Min.	Machine Belts, Per Cent Tension Increase	Countershaft Belts, Per Cent Tension Increase
1,000	8.5	8.5
2,000	7	7
5,000	2	0

Average, both types of belt, 5.5 per cent.

Corresponding increase in bearing friction at 200 r.p.m.

	Per Cent
Babbitt bearings	4.5
Spiral roller bearings	4.2
Ball bearings	5.2

Belt Windage—Belt windage is increased 5 to 10 per cent, with the increase in motor speed on reduction of load, because these losses increase as the square of the belt speed. This factor may, however, be more than offset by the fact that some machine belts are not running during the test.

Pulley Windage—This loss increases with increase of motor speed at light load. It increases somewhat faster than the square of the pulley speed—say 7 to 15 per cent in ordinary cases.

Creep and Slip—Belt creep and slip are largely eliminated and must be determined separately from speed measurements and added in order to obtain full load losses.

Unaccounted-For Losses—Unaccounted-for losses increase slightly with load because:

(*a*) More countershaft belts are on loose pulleys.
(*b*) Some belts drag slightly on the tight pulleys.

Study of the above indicates that the discrepancies between friction load determinations with machinery idle and with it running are not large, and moreover tend to offset each other. This fact was roughly indicated by the Dodge and Day tests sponsored by Hess, discussed in the preceding article. As a result, their tests, which were run in a very special manner to eliminate just this variable, nevertheless give results in good agreement with those obtained by ordinary methods on similar drives.

Some notes on the difficulties and uncertainties ordinarily attending friction-load tests may be helpful. Had these suggestions been available fifteen years ago when I began to make such tests they would have saved much wasted effort.

1. Bearing friction varies greatly with bearing temperature. Thomas's tests show this. If it is impossible to obtain a no-load test on a Saturday afternoon, it is useless to make it Sunday morning unless the shafting is run at least two hours to warm up the bearings. If a test is to be run after quitting time at night or Saturday afternoon, the shafting should be run until the test is made. A few minutes' stop to insert instruments is not serious.

2. If results are required closer than approximately 30 per cent, it is necessary to make several tests and average them. Friction losses on a given shaft will vary greatly from day to day. We once ran a long series of tests on the same shaft, using different types of bearings and different grades of oil, and searched diligently for the causes of daily variations. We tried to connect them with the room temperature, but with no success. The belief that floor deflections due to movement of stock piles on the floor above were the cause was disproved by tests.

Eventually someone noticed that there was a decided difference in the results obtained on rainy days and on bright, sunshiny days. Determinations of relative humidity at each test showed a rough relation to the test results. The change in length of a leather belt with humidity is opposite in direction to that of cotton belting. This change is sufficient to vary the loads on the bearings greatly, with a resultant variation in the friction losses, as shown by the curves on the preceding page.

3. When the total losses in a group drive are 5 to 15 per cent of the total load, as is usual, and when the test is made by measuring motor input, it is ordinarily sufficient to determine the motor losses by measuring the electrical input with the belt off. The increase in losses of either d.c. or induction motors is small between no load and 15 per cent load, provided that the voltage is constant.

4. Care should be taken that the voltage during the friction-loss test and the motor-loss test is closely the same. The light-load losses of both a.c. and d.c. motors vary greatly with a change in voltage. It is generally advisable to determine motor losses at each test of a series. Very often the motor losses exceed the friction losses; so a 10 per cent variation in motor losses may introduce a considerable error in the final results.

Field Tests on Group Drives

After one has believed for a long time that nearly all the friction in group drives occurs in the main lineshaft bearings, the foregoing analysis may be unconvincing. To combine belt losses built on one set of tests, pulley losses on another, and bearing losses on a third, may seem farfetched. How do the results of actual field tests bear out the foregoing conclusions?

In Table II are summarized the results of fifteen conventional lineshaft friction tests, together with the power required to drive the groups when the machines are shut down. The motor losses have been deducted. Ten of the tests cover groups with babbitt bearings on the lineshafts; four, with spiral roller bearings on the lineshafts but babbitt bearings on the countershafts; and one, a group with ball bearing lineshaft hangers.

These tests bear out our analysis based on the detailed consideration of the various losses. Thus:

1. The average amount of power lost in the groups is 14 per cent.

2. It is evident that the number of

*Transactions A.S.M.E. VII, p. 549.

†Transactions A.S.M.E. XXXI, p. 29.

countershafts and machines in the group influences the percentage of loss far more than do the length of the lineshaft and the number of lineshaft bearings. A group with many countershafts and machines may have anti-friction bearings on the lineshaft; nevertheless a group of similar horsepower rating having more lineshafting but fewer machines in the group, always shows a lower percentage of friction. Thus the increased pulley and belt windage and the greater number of countershaft bearings more than balance a considerable per cent saving in the friction of each lineshaft bearing, or even a decided increase in the number of lineshaft bearings.

Cursory examination of Table II would indicate that drives with babbitt bearings show lower friction than drives with ball or roller hangers. Further consideration will show that this is not a fair conclusion. All the roller bearing drives are devoted to less favorable applications than are the babbitt bearing drives—more overhead shafting, countershafts, pulleys and belting per horsepower. Moreover, the ball bearing application was at higher speed.

Very careful tests were made on item 15 to determine the saving in power from the use of ball bearing hangers. The decrease in friction load was less than the day-to-day variations in tests which were due to change in oil viscosity with temperature, change in belt tension with humidity, and the like, but by running tests daily for several weeks these variables averaged out and the ball bearing hangers showed results comparable with those indicated in the curves in previous articles.

If it is admitted that ordinary friction load tests on groups made as discussed before give a fair approximation of the truth, an independent check on the data in the various items of losses may be obtained.

I have data for three tests on drives of about 35 hp., two at 200 r.p.m. and one at 300 r.p.m. These drives approximate 100 ft. of $2\frac{7}{16}$-in. shafting with six to nine driven machines in each group. Table III presents an analysis of these three tests.

One of the 200 r.p.m. drives tested was a group of large foundry mills. The test data include losses in certain bearings on the short shaft driving groups of four mills. These bearings are only 1 ft. above floor level and are exposed to sand from the mills.

Conditions on the 300 r.p.m. drive were more favorable for low friction losses; there were no bearings exposed to sand, no heavy flywheels on machines, nor other sources of abnormal losses.

The two 200 r.p.m. drive tests are averaged and presented in a single tabulation. The agreement between the total of the various losses, as estimated from data given in the preceding articles in this series, and the total losses as determined by individual tests on the drives in question, is most gratifying.

The miscellaneous and unaccounted-for item is arrived at by taking the difference between the total losses as determined from tests, and the total of the estimates of the individual losses. This item is not solely a measure of the inaccuracy of our detailed estimates. It includes also the power lost by the dragging of belts on shifter forks, the friction of crossed belts, losses of belts that drag over a fraction of an inch on a light pulley, when running on a loose pulley, and other minor losses.

For the 300 r.p.m. drive I have also a record of the losses with all belts removed except the motor belt and one belt from the lineshaft to a countershaft. There is included only the lineshaft hanger friction, pulley windage, and the losses in the motor drive belt. These losses totalled 580 watts, which is 17 per cent of the total "friction" losses in the drive, not including belt slip and creep. This indicates that the tabulated data give friction losses in lineshaft hangers greater than the actual losses in this group.

These examples cannot be said to be average examples selected from the whole range of group drives in industry. They are characteristic of well-planned drives with:

Speeds—not more than 300 r.p.m.

TABLE II — RESULTS OF FIFTEEN FRICTION LOAD TESTS ON LINESHAFT GROUPS

	Type of Work	Lineshaft Bearings, Type	Counter- and Jackshaft Bearings	Machines in Group Number	Lineshaft R.P.M.	Lineshaft Length, Ft.	Lineshaft Size, In.	Hp. of Motor	Total Average Hp. Load	Maximum 1-hr. Load, Hp.	Lineshaft, Countershaft and Belt Light-load Losses	Light-load Loss Per Cent of Average
1	Foundry mills	14 babbitt	6	..	200	99	$2\frac{3}{4}$	50	40	53	4	10
2	Foundry mills	13 babbitt	6	..	200	99	$2\frac{3}{4}$	50	$25\frac{1}{2}$	$42\frac{1}{2}$	3	12
3	Wood working	13 babbitt	3	..	300	40	$2\frac{3}{4}$	50	45	80	7.35	16
4	Cordage	13 babbitt	2	..	...	18	$3\frac{3}{4}$	40	35	?	3.8	11
5	Heavy grinding	13 babbitt	3	..	200	240	$2\frac{3}{4}$	100	80	110	7.2	9
6	Canvas	13 babbitt	11	..	225	75	2	5	3	8	0.212	7
7	Canvas	13 babbitt	11	..	225	59	2	$7\frac{1}{2}$	5	7	0.562	11
8	Press	13 babbitt	7	..	200	45	$2\frac{3}{8}$	$7\frac{1}{2}$	7	17[g]	3.32	47
9	Wood pattern	13 babbitt	11	..	200	50	$2\frac{3}{8}$	15	$11\frac{1}{2}$	?	1.55	13.5
10	Forge shop	.....	14	..	200	267	$2\frac{3}{8}$	100	100	130	12.5	13
11	Machine shop	10 roller	12[a]	8	200	75	$2\frac{7}{16}$	...	21.4	25	2.7	11
12	Machine shop	15 roller[b]	26[c]	24	200	93	$2\frac{7}{16}$ and $1\frac{15}{16}$	...	24.3	27	6.6	27
13	Machine shop	7 roller[d]	12[c]	12	200	46	$2\frac{7}{16}$ and $1\frac{15}{16}$	10	10	12	1.6	16
14	Machine shop	18 roller[e]	31[c]	33	200	126	$2\frac{7}{16}$ and $1\frac{15}{16}$	...	14.2	19	4.88	34[f]
15	Wood working	13 ball	9[c]	..	300	99	$2\frac{7}{16}$ and $2\frac{3}{16}$	30	35	...	4.55	13

Average. The total light load losses are 14 per cent of the total average load.

[a] Belts off four counters during test.

[b] 11 spiral roller and 4 ball.

[c] Includes some loose pulleys on machines having no countershafts.

[d] Spiral roller 5, babbitt 2.

[e] Spiral roller 18, babbitt 3.

[f] Drive planned for 40 hp. ultimate. Friction load greater then because of addition of several more counters.

[g] Not 1-hr. maximum. This peak lasts only a few minutes.

Belt slip and creep are not included. To approximate full load losses add 5 per cent for belt slip and creep.

Average horsepower required by group—15 to 20

Number of machines per group—not more than two to twenty, depending on the horsepower

Length of lineshaft—not more than 100 ft.

In the industries with which I am most familiar, these examples would be characteristic of, roughly, 60 per cent of the intelligently planned group drives. These 60 per cent of drives would represent 80 per cent of the power used in group drives.

It is self-evident that if a lineshaft is installed and run all day with no machines connected to it, the loss, no matter how small, will be 100 per cent of the power used in the drive. From 50 to 90 per cent of the power used can be saved by using the proper anti-friction bearings.

If a few scattered machines requiring only a small amount of power are added we have an extreme example of a drive having a very high ratio of friction loss to useful load. Such drives are usually groups where the length of the lineshaft and number of countershafts is large compared with the total load. This condition may result from:

1. Very light manufacturing, so that in a group covering the largest desirable area there is a considerable number of countershafts, but less than a reasonable horsepower load for the smallest size of shafting it was considered desirable to install.

2. Machines that require power intermittently, so that although lineshaft and countershaft friction are always present, the average total load is small.

3. Groups of small machines that cannot be placed reasonably close together, so that an excessive length of shafting is necessary.

In all such cases a relatively large saving will be afforded by anti-friction bearings.

There are various special conditions that also result in high relative friction losses. For example, note the eighth group in Table II. Here seven punchpresses require an average of 7 hp., and a maximum of 17 hp. The load is intermittent and the shafting too large for the drive, but the principal cause of the excessive friction is that the "loose pulley" on a punchpress is the heavy flywheel. The friction in these flywheels should not be charged up to the drive, but as friction-loss tests are ordinarily run, it is included in the load.

TABLE III — FRICTION AND OTHER LOSSES IN GROUP DRIVES OPERATING AT 200 R.P.M. AND 300 R.P.M.

	—200 R.P.M.—			—300 R.P.M.—		
		Per Cent of Total Friction and Windage Losses.	Per Cent of Average Power to Group		Per Cent of Total Friction and Windage Losses.	Per Cent of Average Power to Group
Average load on group....	—32.6 hp.—			—35 hp.—		
	Watts			Watts		
Hangers (babbitt bearings)..	436	17	1.8	715	21	2.7
Counters.....	872	33.5	3.6	1,430	32	5.5
Pulley windage.....	107	4	0.4	295	9	1.1
Belting windage.....	560	21.5	2.3	775	23	3.0
Miscellaneous and unaccounted-for losses by difference.....	625	24	2.6	185	5	0.7
Sub total by independent test.....	2,600	100	...	3,400	100	...
To this add belt slip and creep losses which are not determined by either method...	1,000	....	4.0	1,100	...	4.0
Grand Total.....	3,600	....	14.7	4,500	...	17.0

■ ■

On page 581 G. I. Ross introduces a series of ten articles which will discuss maintenance forms and order routines used in representative plants throughout the country

BOOKS

Handbook of Industrial Electricity

By Max Kushlan. McGraw-Hill Book Company, Inc., 330 West 42d St., New York, N. Y. Leather binding; 535 pages; diagrams and tables. $4.

THIS book is intended to furnish practical information on electricity as applied in the industries. It is designed as a non-technical reference book for those who are engaged in all branches of electrical work. Topics are arranged in the order in which an elecrical worker would naturally advance from apprentice to master electrician, foreman, inspector, maintenance superintendent, estimator, and contractor. The field covered includes wiring for light, power, telephones, and signals in residential, public, and industrial buildings, and for outdoor installations.

A method of reading electrical drawings and diagrams, and methods of estimating the costs of electrical installations have been included, as well as a division treating of special industrial installations, such as wiring in industrial plants, radio stations, heat applications, and automotive engines.

At the close of the book are handy tables of inches as decimals of feet, functions of numbers, per cent voltage drop in feeders, and the like.

■

American Standard Safety Code for Elevators

Published by American Standards Association, 29 West 39th St., New York, N. Y. Second revision, 173 pages. $1.

THIS code is intended as a guide to state and municipal authorities in the drafting of their regulations and may be adopted by them in whole or in part. It is intended also for use as a standard reference for safety requirements.

The first edition of the Safety Code for Elevators was published in January, 1921. In July, 1925, a revision of the 1921 Code was completed, approved by the A.S.A., and published as an American Standard. A revision of the 1925 Code was undertaken, and approved in 1930, to clarify certain of the rules and to include new material.

This latest revision follows the form and arrangement of the second edition quite closely, although a considerable amount of new material has been added in several places, notably under definitions, and in the various sections covering safeties, terminal stopping devices, buffers, and interlocks.

LUBRICATING SYSTEMS

for Special Applications

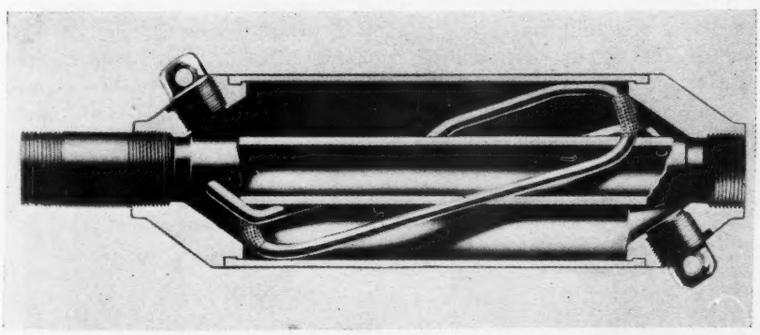
FRED H. LOW
Mechanical Engineer

Tenth article of a series. The next will appear in an early issue.

SMALL air tools often are lubricated by introducing oil into the air line. Two devices developed for this purpose are shown in Fig. 65. The lubricator at the top consists of a cylindrical reservoir surrounding a tube through which the air passes. Placed around this inner tube is a tube of small diameter, the two ends of which enter the larger tube at opposite ends and on opposite sides.

When air flows through the central tube, the difference in pressure at the two ends of the smaller tube causes oils to flow through the screen of the small tube and thence into the main airline.

The oil reservoir of the other unit, shown below, is in the center. The main air stream is around the reservoir, which has no marked effect on the oil injected into the line. A small nozzle is extended through the center of the reservoir. The air which enters this tube is discharged through an opening in the oil reservoir at which point a venturi action is set up that causes the oil to be drawn into the main flow of air. The amount of oil delivered may be regulated by varying the distance from the venturi at which the nozzle discharges.



Courtesy The Cleveland Rock Drill Company

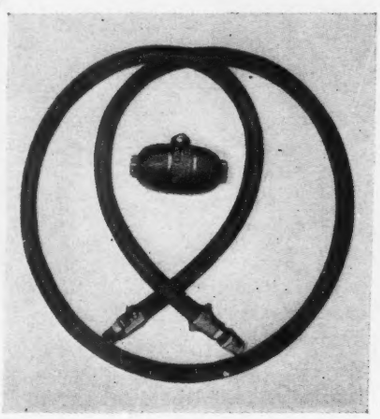
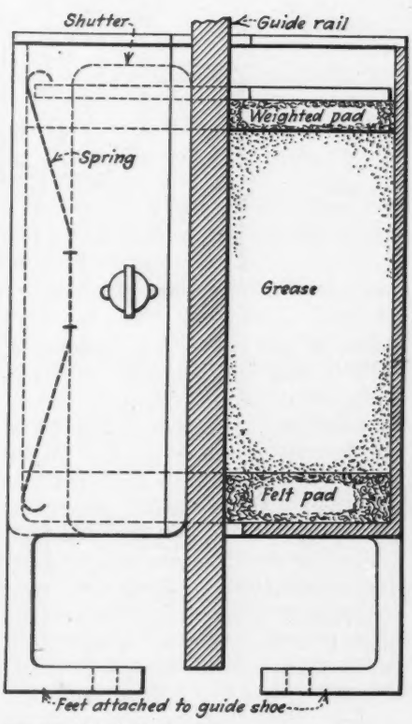


Fig. 65—Devices for supplying lubricants to small, air operated tools. Pressure difference controls the supply in the above unit, whereas the supply is regulated mechanically in the device at the right.



Courtesy Yvan Zenon

Fig. 66—Section through guide rail lubricator in which a compound of light grease and graphite is used. When used on elevators, the lubricant is supplied only when the car is in motion.

In many instances the wipe method of lubrication, one of the early forms, constitutes the most economical means of application. On long surfaces, such as elevator guides, it is particularly appropriate. With properly designed applicators only a thin film of lubricant is applied over which the

shoes ride without removing any lubricant in passing.

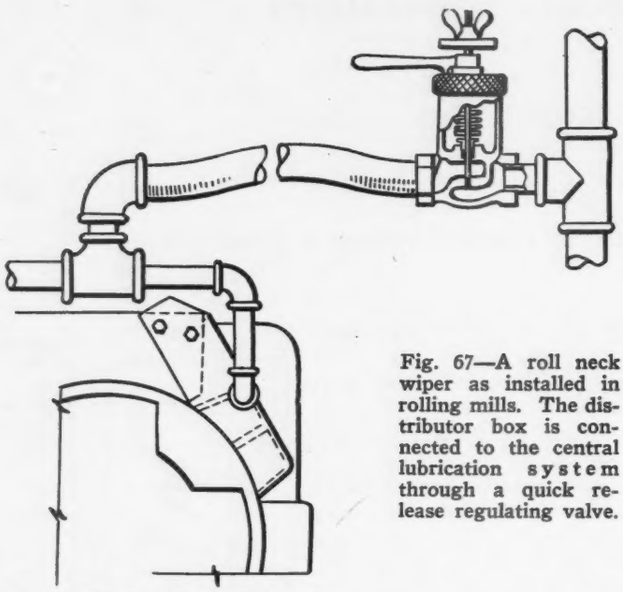
A section through a lubricator of this type is shown in Fig. 66. It is designed to be mounted on the upper end of the top shoes on the car and counterweights, and consists of a chamber fashioned to fit onto the guide rail and bring the lubricant in contact with the three working surfaces of the rail. A compound of light grease and graphite is recommended by the manufacturer. There is a felt pad, as shown in Fig. 66, at the bottom of the reservoir. It acts as a packing to keep the grease in the reservoir and also to prevent an excess from getting on the guide rail.

On top of the grease is a weighted pad which tends to keep the grease in contact with the rail and at the same time prevent too much grease from being deposited on the rail when the lubricator is moving downward.

Two fiber shutters, one of which is outlined to the left of center in Fig. 66, make a tight joint with the guide rail, thereby completely inclosing the reservoir on the rail. These shutters are held to the rail by means of springs that allow side motion of the shoes without interfering with the seal of the lubricator with the rail.

Such a lubricator supplies grease to the guide rail only when the car is in motion and, because there is no excess, there is no accumulation of oil at the bottom of the shaft or on top of the car. The lubricator reservoir holds approximately two pounds of grease which, according to the manufacturer, is sufficient to last a year on an elevator in average service.

Another place where the wipe method of application has proved its worth is on rolling mill necks. The details of application with this method are shown in Fig. 67. Lubricant is supplied to the distributor box by means of one of the grease pressure systems already described. The box distributes and applies just the film of grease required.



Courtesy Keystone Lubricating Company

Fig. 67—A roll neck wiper as installed in rolling mills. The distributor box is connected to the central lubrication system through a quick release regulating valve.

A grease of medium consistency, which is impervious to water, and which possesses a relatively low coefficient of friction and a super-film strength is used.

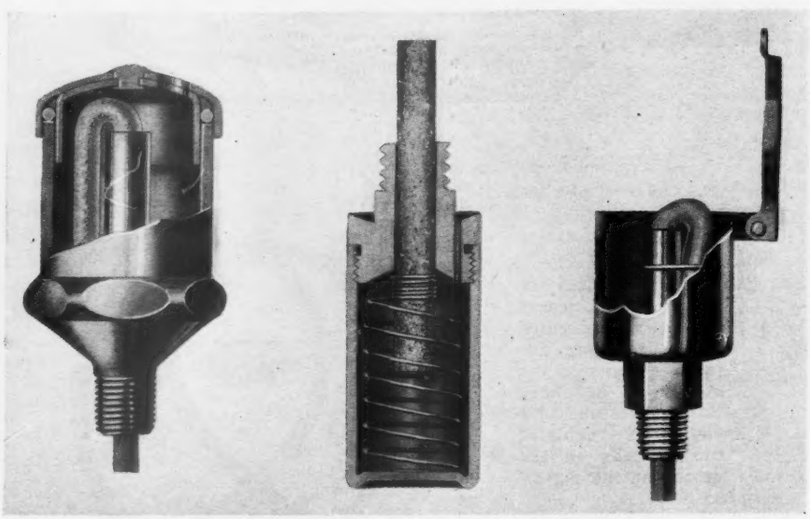
On a 10-in. rod mill, operating at the rate of 600 r.p.m., and rolling steel reinforcement bars at the rate of 1,500 f.p.m., the power load was reduced from 300 to 150 amp. by the application of the equipment and lubricant described. In this class of service adequate lubrication has a distinct effect on the roll adjustment.

The bearings of some lineshafts, and those of practically all railroad car axles, are inclosed in journal boxes which are provided with sufficient waste or felt to convey the lubricant by capillary action to the bearings. In previous articles it was pointed out that lineshafting and other bearings are sometimes lubricated by the use of oil cups having wick feed. The end of the wick makes contact with the rotating part. A wipe oiler of the inverted type is shown in Fig. 68. It is used on fans, igniters, small motors, small dynamos, and other kinds of high-speed machines. It feeds the oil to the lower side of the shaft, and only when the machine is in operation. Only sufficient oil is supplied to take care of the bearing, there being no surplus to be thrown off the shaft.

Although the use of fabric is common asbestos and soft wire are used in making the wicks. The flow of oil may be governed to some extent by the size and capillary capacity of the wick, and the viscosity of the oil.

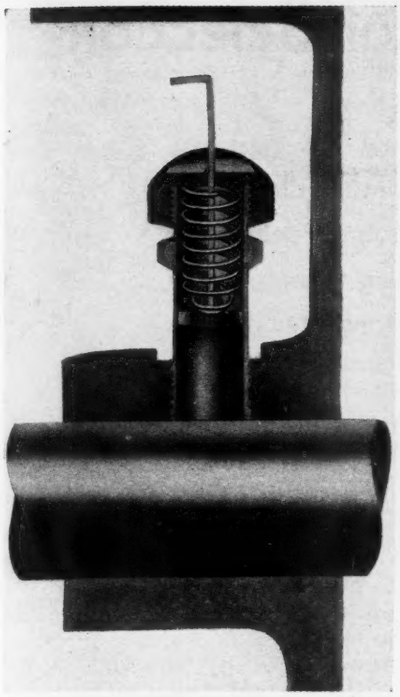
A convenient method of applying grease by the wipe method is shown in Fig. 69. The applicator, which is shown mounted on a loose pulley, consists of three parts—the brass tubing, the cap, and the weight with lubricator indicator. They are made for a press fit installation for stationary service or with a threaded end for use on moving parts.

The lubricant, which has an animal



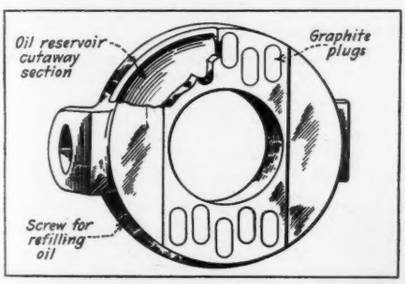
Courtesy Bowen Products Corporation

Fig. 68—Oil cups of the modified wick type. The middle oiler feeds the lubricant to the under side of the shaft.



Courtesy Swain Lubricator Company

Fig. 69—Grease for this lubricator is supplied in the form of candles. The spring keeps the grease candle in contact with the shaft which picks off the lubricant as it is required.



Courtesy Randall Graphite Products Corporation

Fig. 70—A wipe system built into a clutch release bearing.

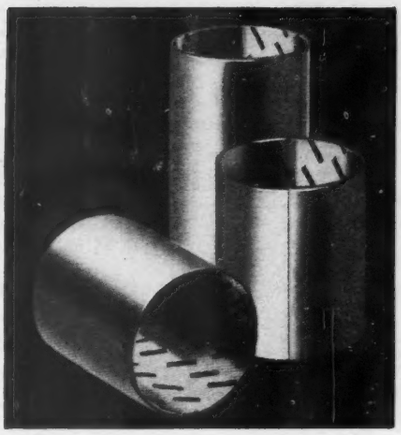
fat base, is molded in cylindrical form to facilitate charging the applicator. It has a melting point of 130 deg. F. and will not feed to the bearing when the shaft is standing still. A weight keeps the candle against the revolving part which picks off the lubricant as it is required. Dust and dampness are kept out of the bearing by a small ring of grease that forms around the shaft, just outside of the lubricating box. Because there is no drip, the bearing can be used on line shafting where fabrics are manufactured.

A system of wipe lubrication may be built into the parts themselves, as shown in Fig. 70. The part illustrated is a clutch release bearing which is hollowed out to provide storage capacity for the lubricant. From this reservoir, which is filled with oil, sufficient seepage takes place through the special graphite plugs to lubricate the face with a graphite and oil mixture. The reservoir may be refilled through a screw plug in the bearing. This bearing is a cross between a dry or oilless bearing and one that is lubricated by the wipe method.

Several types of oilless bearings have been perfected, which may be identified by their construction. They are classified as the hardwood or metal types. In the former type, hard, seasoned wood, impregnated with some substance having lubricating qualities, is employed. Although the early wooden bearings and some of the later ones are of the block type, it is now the practice to form the wood into bearings and bushings of the same design as those of the metal types.

Made in the form of the standard bronze backed babbit bearing, as shown in Fig. 71, the metal type of oilless bearing is grooved or drilled to receive the anti-friction material which, in some cases, is graphite forced into these voids under hydraulic pressure. Thus it is seen that the reduction of friction depends on the quality of the lubricant. As the graphite is flush with the bronze it will be consumed only as the bearing itself wears.

Metaline, a composition of metallic oxides and other substances reduced to a powder and then solidified, has a slightly different action from graphite. The particles of Metaline, by filling in voids and wearing off high spots, produce an extremely high polish which permits the bearing to operate without a lubricant between the rubbing surfaces.



Courtesy Johnson Bronze Company

Fig. 71—In the metal type of oilless bearing the lubricant is forced into voids under hydraulic pressure. The original charge supplies lubricant throughout the life of the bearing.

Oilless bearings are used extensively on textile machinery, where oil or grease would be detrimental to the product. Other applications are parts of machines difficult of access, and loose pulleys which run under light loads.

Solve Your Loose Pulley Problems

IN MANY shops the loose pulley is a major cause of trouble, loss of time, and waste of money, energy, and patience. Often the pulleys in a plant are not given frequent enough attention; loose pulleys, especially on machines used only at intervals, are apt to be overlooked entirely. Sometimes the maintenance man, replacing a pulley, neglects to provide a lubricant cup or retainer. Frequently he bores the bushing oversize, or makes it too tight, thus producing a slipshod job at the very start. It is well to bear in mind that cup grease requires more clearance than machine oil, so that a bushing to be used with an oil cup should not be a snug fit. Moreover, there should be grooves in the bushing to receive and retain some of the lubricant. Too often a shaft is permitted to remain, no matter how worn or scored, instead of being replaced by another.

A loose pulley may entail a highly disproportionate cost in a year's time. Thus, on a certain machine there was a pulley with an unusually long belt, 5 in. wide, running from jack shaft to floor countershaft. Every few months it would start the familiar rattling which bespeaks a wornout bushing. A new countershaft meant an expenditure of $4. Removing the pulley, bushing it, then restoring it, involved an outlay of $5 more. In the course of a year the additional cost on the machine totaled about $50, in addition to the annoyance and vexation attached. Therefore it is economy of the wisest order to procure pulleys of the most modern type. Ball bearing loose pulleys are to be recommended, for they run several months without attention. It is a better procedure, of course, to apply oil once a week, and not only when time affords.

Environment in Electric Motor Selection

To buy a standard motor just because of low first cost, when plant surroundings—dust, dirt, gas—warrant the choice of a special, inclosed type, is penny wise and pound foolish. Increased maintenance costs, accidents resulting from unnecessary hazards, and faulty operation demonstrate this

H. M. FRENCH
Industrial Engineering Department
General Electric Company
Schenectady, N. Y.

AFTER the horsepower, speed, and starting characteristics of a motor have been determined for a certain job, the environment should be considered carefully. Most applications require only a normal design of motor and control for successful operation. Some industries, and some places in most industries, are characterized by conditions of dust, gases, or moisture that require modification in design in order to insure uninterrupted service and normal maintenance costs.

For an industrial application one may purchase either a standard motor and standard control at a minimum of outlay, or a higher priced motor and control designed for specific conditions. The former may seem more economical, but the savings realized on the original transaction may later be spent many times over in lost production and excessive maintenance.

Dust — Dust may be defined as matter in such a finely divided condition that it floats freely in the air and behaves like vapor or smoke. No industrial plant can be entirely free from it.

In their characteristics industrial dusts generally may be grouped as conductive, explosive, abrasive, magnetic, or corrosive (when wet). Typical kinds of dusts are coal and coke; graphite; bronze and aluminum; sand, stone, and emery; flour, starch and grain dust; and iron and steel. The accompanying chart (Fig. 2) shows the important characteristics of each kind, and indicates which ones are held in common by several kinds.

Probably magnetic dust has the most destructive effect on electrical equipment, especially on motors. The iron or steel present in this dust makes it extremely responsive to magnetic flux. When it settles on the motor windings and is acted upon by the flux surrounding the windings, the particles vibrate rapidly, eventually work their way through the insulation, and so cause trouble.

The conductive dusts are nearly as destructive. The particles settle on various parts of the machine or control panels and tend to create leakage paths. Thus an arc may be drawn between metallic parts. Although conducting dust is soon burned away, the arc may continue until the equipment is damaged. Another and, in high voltage machines, more dangerous effect of this type of dust is that it may cause a leakage path between live parts and the frame, so that unless the frame is thoroughly grounded an operator may receive a severe shock.

Abrasive dusts also are deleterious

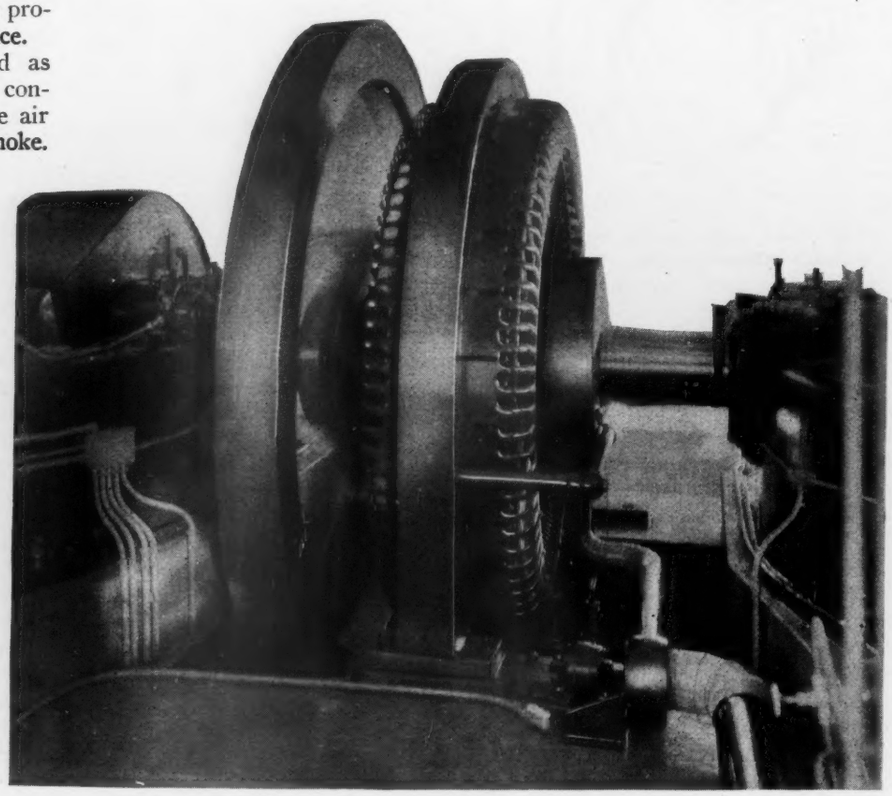


Fig. 1—A 400-hp. synchronous motor driving a reciprocating gas compressor. The collector rings are completely inclosed and ventilated by a motor driven blower which maintains a positive pressure in the inclosure.

to motor windings. As the fine particles are drawn into the motor and pass over the windings, they knock off bits of insulation until the live metal is exposed and a leakage path is produced. Such dust will also get into bearings unless thoroughly dust-tight housings are provided.

Explosive dust, such as flour, starch, coal dust, bronze powder, and the like usually are not directly injurious to motors. However, unless the machines are systematically and properly cleaned, such dust will fill the air passages and cause the motor to run hot, thereby weakening the insulation and materially shortening the life of the motor. They also create an explosion hazard.

Many dusts of various sorts produced in chemical plants, as well as coal and coke dust, are practically harmless when dry, as regards corrosion. However, when moist they become very active and will corrode metal surfaces. In adition, they may form conducting paths across insulation.

Inclosed Motors—There are two reasons for inclosing motors working in dusty locations: First, to protect the motor from injury. Second, to protect the plant and other equipment against explosion.

Dust encountered in grain elevators, flour mills, starch factories, coal-handling plants, and the like is dry and extremely explosive. These location have been designated as Class II in the National Electrical Code and include those in which "combustible dust is thrown, or is likely to be thrown, into suspension in the air in sufficient quantities to produce explosive mixtures, or those where it is impracticable to prevent such combustible dust from collecting in such quantities on or in motors, lamps, or other electrical devices that they are likely to become overheated because normal radiation is prevented."

Obviously, normal, open motors are impracticable for such locations. Totally enclosed, fan-cooled motors, in which the windings and other parts are protected from dust by a tight metal housing are available. A fan aids the dissipation of heat, for normal air circulation is cut off by the inclosure.

Pipe-ventilated motors are sometimes used. A pipe is run to the outside of the building or to some other place from which a supply of cool, clean air can be obtained. Circulation is maintained either by internal fans or by a separate blower.

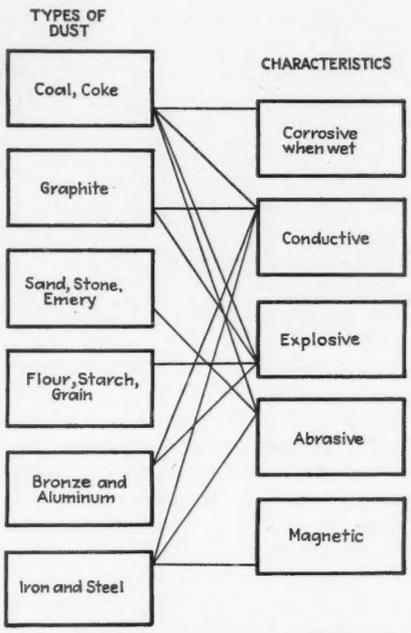


Fig. 2—This chart lists the various kinds of dusts encountered in industry, and shows their main characteristics, many of which are held in common.

Insulation — Electric motors are usually provided with one of two classes of insulation, defined by the A.I.E.E. Standards as Class A and Class B. Class A insulation consists of "cotton, silk, paper and similar materials when so treated as to increase the thermal limit; or when permanently immersed in oil; also enameled wire."

The maximum safe temperature for this kind of insulation is 90 deg. C., or 50 deg. C. rise over a 40 deg. C. ambient temperature.

Motors which operate in higher ambient temperatures or which have a higher temperature rise are equipped with Class B insulation consisting of "mica, asbestos and other materials capable of resisting high temperatures, in which Class A insulation is used in small quantities for structural purposes only."

The maximum safe temperature for Class B insulation is 110 deg. C., or 70 deg. C. rise over a 40 deg. C. ambient temperature.

The insulation used on the windings of normal motors is often sufficient for use in dust conditions. Where extra insulation is required, extra tapings and varnish treatments are given. Varnished cambric tape and clear varnishes are ordinarily used, since they present a hard, smooth, glossy surface upon which dust cannot readily act.

Rotors of squirrel cage motors are ordinarily of the one-piece cast aluminum type without insulation, and thus are not affected by dust. Rotors of wound rotor motors may be given extra dippings in varnish, and metal

Fig. 3—Totally inclosed, fan cooled, d.c. motor driving a tumbling barrel in a foundry. In this industry the motor must be protected from metallic dust as well as from sand.

connections may be covered with caps, to prevent dust from causing short circuits. Often the collector rings of wound rotor induction motors or synchronous motors can be inclosed.

High voltage motors are usually placed in separate motor rooms.

Moisture and Vapor—One of the problems in connection with the selection of motors and control for paper mills, parts of dyehouses, bleacheries, packing plants, and the like, is the presence of excessive amounts of moisture in the form of steam, excessive humidity, or splashing or dripping water. This moisture will be drawn into a motor through the normal air passages and, in the event of a shutdown, by "sweating." In this way it reaches the most vulnerable spots of the motors. It usually has enough mineral, salt, or acid in solution to be fairly conductive. The moisture grounds the surface of the coils and attacks the insulation. If the water gets through to the copper it forms a creepage path to ground or between phases, and leads to failure.

Perhaps the best way to take care of this problem is to use a totally inclosed, pipe-ventilated motor. The location of the inlet should be carefully selected for clean, fresh, dry air. Another expedient is to provide a small electric heating unit in the base of the motor, arranged so that as soon as the motor is shut down the heater is turned on. A very small heater will keep a motor dry and in good operating condition, and is particularly applicable when motors are to remain idle for long periods, as during the winter season.

Where open motors are to be used in the presence of excessive moisture, extra insulation is needed. The object is to build up a stronger continuous film or seal over the windings, to the total exclusion of capillary passages. This is done on random wound stators by applying additional insulation before applying the final protective compound. Form wound coils are provided with heavier insulation on the slot portion, and the ends of the coils receive additional tape and varnish treatment so as to have a heavier coat of insulation over the entire coil.

The use of low voltage motors will also aid in minimizing troubles with moisture.

Gases—The selection of motors for use in gaseous locations is primarily one of reducing the hazard to plant and personnel, although the motors must be properly protected from destructive gases. These locations are defined as Class I in the National Electric Code and include locations "in which flammable volatile liquids, highly inflammable gases, mixtures, or other highly inflammable substances are manufactured, used, handled or stored in other than their original containers."

Today "explosion proof" motors are available, approved by the Underwriters Laboratories, for use in Class I Group D locations. The motors are, in nearly all cases, totally inclosed, fan-cooled, with extra heavy frames, long close fits, and other safety features. Rather than to prevent the entrance of gas, they are

Fig. 6—Totally inclosed, fan cooled motor suitable for use in Class I locations. This motor is provided with an extra heavy frame, long close metal-to-metal joints, non-sparking cast aluminum fan, and heavy conduit box.

Fig. 4 (Below)—Totally inclosed, fan cooled induction motor driving a receiving belt in the dustiest place in a grain elevator.

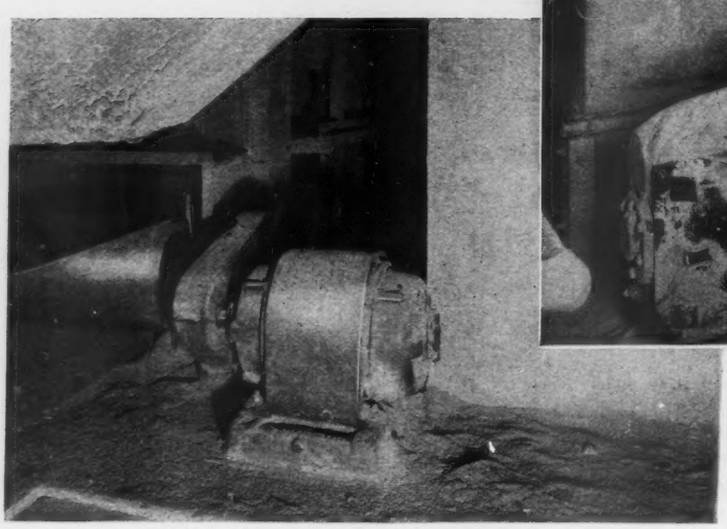


Fig. 5 (Above)—Totally inclosed, fan cooled, d.c. motor driving a magnetic belt for extracting iron from slag.

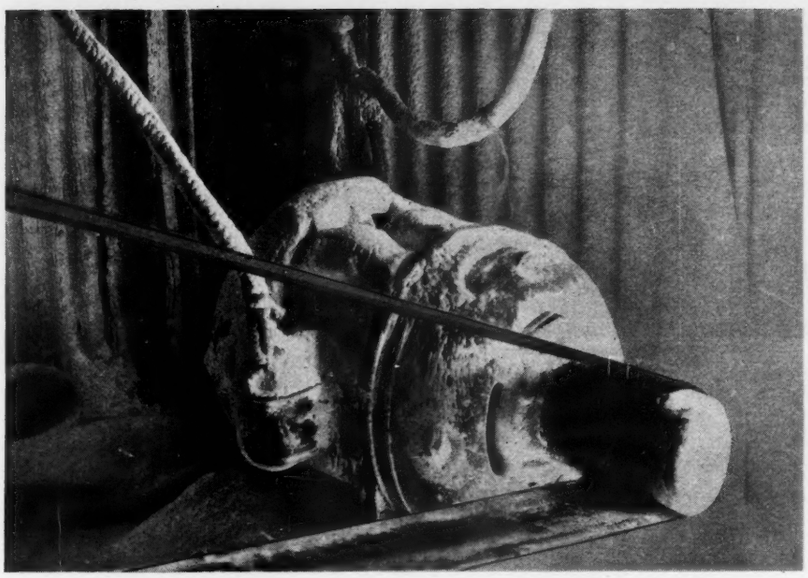


Fig. 7—Totally inclosed, fan cooled induction motor driving a lime elevator for neutralizing waste sulphuric acid.

designed to prevent any flame or heat resulting from an explosion inside the motor, or any sparking, from contacting the surrounding atmosphere in sufficient intensity to ignite it.

Open motors can be located outside a fire wall in some cases to avoid the more expensive explosion proof construction, but many installations call for motors to be directly connected to spray machines, gasoline pumps, and the like. In such instances open motors should never be used.

Control—Control equipment may be roughly classified as dust-tight, moisture resisting, gas proof, and explosion proof. For the usual dust encountered in average service, ordinary control apparatus is satisfactory. However, in places like steel mills, cement mills, foundries, and the like, dust-tight apparatus may be required.

It is often possible to locate the controller in a place not reached by dust and to use a dust-tight push button station or manual controller in the dusty area around the driven machine. However, where the controller must be in the dusty area, it becomes necessary to use dust-tight equipment. Both a.c. and d.c. manual and automatic switches have been developed for this service. The switches are equipped with heavy cast iron or "boiler plate" inclosing cases. Felt gaskets are used. Extra heavy close fitting bolts complete the unit.

Most control equipment is designed to be moisture proof. Where abnormal amounts of moisture are present, the control may be located in a separate room and push buttons located on or near the driven unit.

Equipment for use with motors operating in Class I conditions is of three kinds: (A) Standard hand and automatic controllers located outside the danger area. (B) Standard control apparatus, located inside the danger area, with explosion proof push buttons located in the danger area. The push button stations are totally inclosed with extra heavy cases, long close fits and heavy bolts. (C) Special inclosed air break controllers designed in accordance with the Underwriters Laboratories standard for Class I Group D conditions. This control embodies wide metal-to-metal joints as well as high safety factors in the strength of inclosing parts and bolts.

Oil immersed control devices are also applicable in hazardous gases when they are designed to inclose the connections properly and to protect against open arcs at all times. In some of the very mildly hazardous conditions plain oil-immersed devices have been used with fair success.

Where large control panels or boards are to be used under these adverse conditions it is best to locate them in a separate room.

It is only recently that totally inclosed or totally inclosed fan-cooled motors have been available in any way comparable with normal open motors. Formerly, these motors were large, costly pieces of apparatus that were used only when necessary.

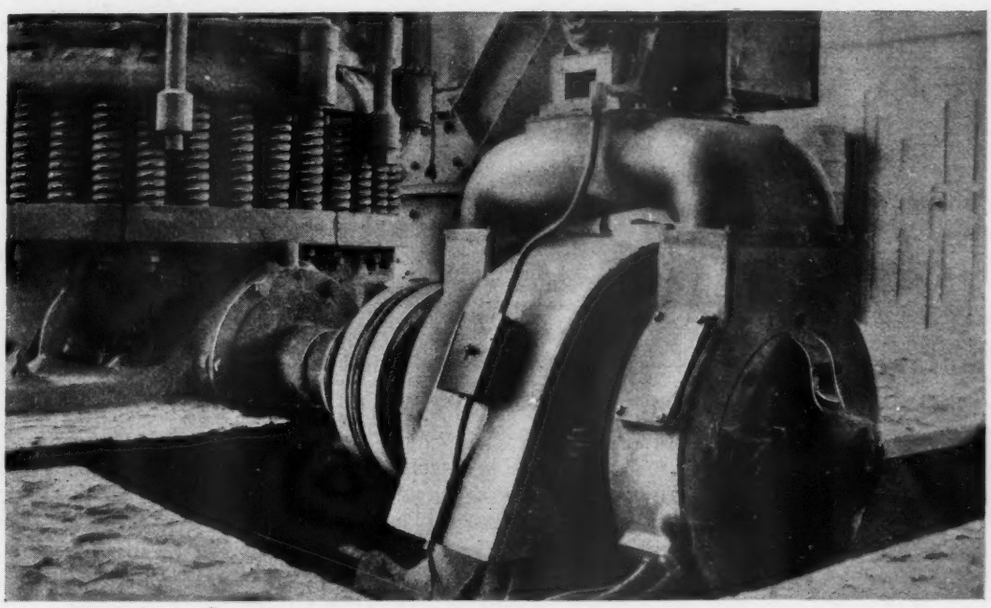


Fig. 8 — Totally inclosed, pipe ventilated motor driving a crusher in a nitrate reduction plant. Ventilating air is forced into the motor by the motor driven blower.

PLANT ENGINEERS' FORUM

A new question is presented each month, and our readers' answers to previous questions are published. Write down your opinions and send them to the editor. Answers published will be paid for.

◆

A Reserve Fund for Maintenance?

In this scene we espy Frank Fulleger and George Shipman wending their way home through the crowd from the football stadium late one Saturday afternoon. Frank is in an exultant mood for the local university team, his alma mater, has just climaxed a successful season by trouncing its ancient rival. Let's catch up with them and hear what they're saying.

* * *

"What a team, George. Notre Dame would be 'duck soup' for those boys the way they were going today."

"Boy, you *are* enthusiastic. Fine team all right, Frank. But it was your reserves that won the day. Notice how good fresh men kept coming in after your opponents had exhausted their supply of substitutes? Smart football!"

"You said it, George. Reserves—say, that word gives me an idea."

"Quick, Frank, before you lose it."

"Every time I've taken one of my pet schemes to the front office this year, I've hit the same stone wall: 'Wish we could buy it, but—no money.' Why no money, George? Why not reserve money for maintenance—reserve money to put new life and courage into a plant in the last part of its battle with depression?"

"Sounds interesting, Frank. As I understand it, you're proposing a reserve or surplus fund for maintenance so that money always will be available for sound expenditures when they are required whether in depressions or booms."

"That's it, George. What do you think of it?"

"In theory it's fine. But where is the money coming from? What should be the size of the fund? And how is it to be accounted for on your company's books?"

"There you go again, George. Think I can answer all of those questions soon, but not until I've done plenty of thinking and figuring. Here's where I turn off. Tell you all about it next time."

* * *

Although inadvertently, George has provided the idea necessary to start Frank's brain working on a new solution of an old problem. Few if any readers of MAINTENANCE ENGINEERING *have not been affected of late by such shortages of funds. Send in your discussion of Frank's suggested solution.*

Should a reserve be established to provide funds at any time for sound maintenance projects?

If so, what steps should be taken to institute and maintain such a fund?

(Answers to previous questions start on the following page)

READERS' ANSWERS

To Previous Questions

Is There Profit in Spending?

(Question presented in the November issue)

THERE are many reasons why it is often profitable to spend wisely if the necessary funds are available—even in periods of depression. At such times competition forces prices to low levels without sacrificing quality and with the best of service and delivery. In these days the trend is too much on the side of patching and repairing obsolete equipment to the point where new equipment is being paid for without the advantages of ownership. When purchases are made with this principle in mind another benefit more important than economic saving is realized—preparedness for business recovery.

In a certain plant a number of lathes, long obsolete but in fairly good working condition, were replaced by half as many automatic, turret-type machines. The new lathes now are doing twice as much work as was performed by the greater number of discarded lathes. In another case molds of an intricate design had been shaped by hand from solid blocks of steel for years—a tedious and slow procedure. The drop-forging process was suggested and tried. It has been used ever since, cutting the cost in half. Similarly, a certain type of circular knife always had been ground and sharpened by hand. Not only was the process slow, but also great difficulty was experienced in finishing the knives to uniform size—an important requirement. The purchase of an automatic grinder and sharpener resulted in lower production costs and better and more uniform knives.

H. L. SCHULTZ
Assistant Superintendent of Maintenance
The Carborundum Company, Niagara Falls, N. Y.

THE MANAGEMENT that is simply waiting for business to improve may find itself sitting on the side lines when orders begin to flow to those who are better prepared. Commodity prices have been lowered in many lines to stimulate buying and to move existing stocks. These prices are not likely to be raised in the near future. Such conditions mean decreasing profits unless immediate steps are taken to reduce costs by effecting improvements in methods and equipment.

Executives who are alive to the situation realize that today is the ideal time to make profitable investments in new machinery. By weeding out obsolete equipment and rearranging machinery and departments to minimize lost motion, they are improving the position of their plants for economic manufacture.

When a machine falters in its daily grind, whether the failure is in the form of excessive maintenance costs or the machine's inability to meet specific standards of accuracy, its fate is sealed. No shop can afford to pay for the floor space that it occupies. Such equipment pays higher dividends on the scrap heap than in the plant.

Another contributor to high manufacturing costs is a machine that raises no warning signal betokened by broken parts or spoiled products. Such a machine still does its job efficiently and is capable of many years of trouble-free service. But it is obsolete because another machine has been designed to perform the same or a better job in a shorter time.

Progress demands that machine improvements be welcomed, not viewed with apprehension. The replacement of equipment that is not fully depreciated is indicative of a progressive point of view when such action can be justified mathematically.

HARRY KAUFMAN, *Engineering Division*
Naval Aircraft Factory, Philadelphia, Pa.

JUDICIOUS spending can be made to show a profit in periods of depression and prosperity alike. In any organization the men in charge of the engineering and mechanical departments should spend part of their time in search of new equipment and methods that either will improve quality or cut costs; a progressive management always is willing to consider the purchase of equipment that will accomplish these purposes. Estimates of the cost of equipment in our plant must show that the proposed apparatus will pay for itself within five years if the project is to receive consideration.

The present recession in business has given most of us an opportunity to devote more time than usual to the study of plant methods and equipment, and therefore the present is an ideal time to "put our houses in order." We must all work for lower unit costs if we expect to survive the present crisis with its increasing competition. The purchase of the proper modern equipment at this time is sure to pay big dividends when prosperity returns—as it surely will.

C. W. SCHWABE
Superintendent Mechanical Department
Mallinckrodt Chemical Works, St. Louis, Mo.

Interviewing Salesmen

(Question presented in the October issue)

THE MAINTENANCE engineer should not interview all salesmen. A properly trained purchasing agent should get out in the shop enough to know how the various supplies are used. To talk intelligently with salesmen of routine equipment the purchasing agent also should have a smattering of technical knowledge gained largely by conferring with the maintenance engi-

neer. For example, if a salesman calls with a lubricant priced lower than that used at the time, the purchasing agent should know enough about his plant's requirements to determine whether there is a possibility of using the product. If in doubt he should consult the maintenance engineer.

The maintenance engineer should let it be understood that he wishes to see any salesman who has helped him to solve a technical problem. He also should see those representatives with whom he is well enough acquainted to obtain extra service in prompt deliveries, advance information on prices, or any other service advantageous to his company. He should, of course, see all salesmen concerned with proposed layouts, new equipment, and process changes.

All salesmen should be treated with utmost courtesy and should be allowed to explain their products briefly. It is not necessary for the maintenance engineer to consume his or the salesman's time by trying to impress the salesman with his knowledge of the subject under discussion. If the salesman is not kept waiting for an unreasonable time and is listened to in a friendly, attentive matter the maintenance engineer will find that such consideration is all that is necessary to obtain the salesman's full cooperation. Unless the salesman's story brings out information about which the maintenance engineer wishes further knowledge, the interview can be terminated quickly without discourtesy.

WILLIAM D. PLUMB, *Factory Manager*
Fayette R. Plumb, Inc., Philadelphia, Pa.

ALL SALESMEN should be interviewed! Maintenance engineers owe it to themselves and their organizations to keep abreast of the new equipment and maintenance supplies that constantly are being offered. They absolutely cannot afford to pass up these messengers of progress because the very ones ignored may have just the products needed.

One unusually busy day a seedy, grimy individual came to our office for an interview with the maintenance engineer. The tendency of the executive was to send word out that he was busy but, because he was asked for personally, access to his office was begrudgingly given. It so happened that he was selling the exact type of chair glide that the purchasing agent had been trying unsuccessfully to locate for some time.

Granted, for the sake of the discussion only, that salesmen are very plentiful and often appear bothersome, without them our plants might be years behind in modernizing themselves. Many executives are deeply indebted to salesmen for ideas graciously and freely given—ideas that turned out to be highly successful in application and profitable in results.

When and how to talk to salesmen are questions requiring individual solution. Small plants having few callers should find the solution quite simple by allowing easy access to the maintenance engineer, preferably at all hours of the day. The informal chats resulting from such visits generally prove to be mutually beneficial.

In plants in which the maintenance engineer has constant calls upon his time from outsiders, many firms have found it profitable to allow salesmen to present their offerings at definite daily hours in the morning and in the afternoon. This arrangement does not mean that the engineer need stop all other work and await callers during these hours. It means, on the other hand, that salesmen can present themselves at no other time except during the time indicated. No salesman could complain of being treated unfairly or of arbitrary rules under such a plan. The expense of salesmen's calls is, in the long run, reflected in the purchase price of their products and, although one individual cannot hope to materially decrease these costs, consideration of this factor by all plant engineers would be sure to produce a beneficial result.

Salesmen should be allowed to tell just as much of their story as the purchaser deems necessary. If the proposition can be analyzed properly and an intelligent decision reached in five minutes, that is exactly the time that the salesman should be allowed. But the maintenance engineer should see them all, some way!

C. S. STEVENSON, *Operating Manager*
Hall Brothers, Inc., Kansas City, Mo.

SALESMEN present a problem to the maintenance engineer that must be handled diplomatically. I believe that the maintenance engineer should interview only the salesmen with whom he has a special problem to discuss. For example, suppose we are having trouble with our die steel. If the salesmen of several steel companies should call during this period we would gladly interview them and try out their samples. But, if the same steel salesmen should drop in at a later date, we would not care to interview them other than to ask them to leave their latest data.

The following system is working satisfactorily in our plant: The telephone operator turns all salesmen over to the purchasing agent who is familiar with the requirements of the maintenance department. When the salesman's product pertains to the maintenance department the purchasing agent telephones the maintenance engineer and asks him if he has any special problems to take up with the salesman. If the maintenance engineer's answer is no, that is the end of the interview as far as he is concerned. If the answer is yes, an interview is arranged. In this way the valuable time of the engineer is saved and the salesman does not go away feeling slighted.

J. CONRAD WATSON, *Master Mechanic*
Franklin Pottery, Lansdale, Pa.

I BELIEVE that the maintenance engineer should interview as many salesmen as his time permits. Interviewing salesmen is the best method of keeping posted on new developments and applications of equipment.

I think, however, that a system should be set up in which salesmen must interview the engineer either by appointment or only during specific hours or days. In large organizations I believe that the majority of salesmen who call on an engineer should be interviewed by his assistant who should keep a record of all information imparted to him. When representatives of special importance call for an interview they should be turned over to the engineer in charge. The use of this system will conserve the maintenance engineer's time for salesmen who have important and interesting stories to tell. The engineer should be specific in asking each salesman to confine his statements to a definite period.

I believe that cooperation between the purchasing and the engineering departments should be worked out

along the following lines: When definite inquiries have been initiated by the engineer he should interview all salesmen concerned by appointment. In many cases routine calls can be handled completely by the purchasing department. Frequently the best procedure is for the purchasing department to get the story and turn it over to the engineer later. But there are many cases in which it is better for the purchasing department to refer salesmen directly to the engineer.

K. D. HAMILTON, *Mechanical Department*
Geo. E. Keith Company, Campello, Brockton, Mass.

THE IMPORTANT point to be considered by the maintenance engineer when interviewing salesmen is the benefit to be derived by his company. If possible the maintenance engineer should see all salesmen. If he reads his trade periodicals, he will be familiar with present practice and the general design of equipment pertaining to his job. Therefore, a discussion of new or proposed developments should be more beneficial to himself and his company than an interview along general lines. If the maintenance engineer were to ask each salesman what he has to offer that is new, he would receive much valuable information. Often such information would be received much earlier than if obtained through regular channels.

My experience in sales work has shown me that the plant engineers who are working at highest efficiency are the men who always are interested in new things. For this reason, in my personal work, I have stressed new developments, which method always has attracted the interest necessary for good results. Because every salesman could make a long story of his sales talk even though he handles but one item, the maintenance engineer not only can receive more benefit, but also can shorten his interviews so that he can see more salesmen by directing the discussions briefly along such channels.

WM. G. MEROWIT, *Sales Engineer*
The Wm. G. Merowit Company
Buffalo, N. Y.

IN ALL cases salesmen, agents, and other representatives should be required to call first on the purchasing department—regardless of their missions. Such procedure not only will save time for the maintenance engineer and others responsible for purchase requisitions, but it also will keep the purchasing department in touch with all inquiries, thus eliminating unnecessary confusion and follow-up.

It should not be necessary for a maintenance engineer to spend much of his time with the salesmen of the routine and supply items that have become standard. Such items should be handled directly by the purchasing and stores departments. The maintenance engineer's interviews with the salesmen of the innumerable items related to improvements and developments should be limited to those of special request or interest. The purchasing department should issue passes only to those salesmen whom the maintenance engineer desires to interview.

Although not always practical, it is well, whenever possible, to arrange such interviews as are found necessary for a certain period of the day. It will be found that a majority of such calls can be pre-planned. In some instances it will be found advisable to include one of the shop foremen in the interview either for the purpose of increasing his practical knowledge or with the view of saving time. It well behooves the head of a maintenance department to keep in close touch with the subject of interviewing salesmen in all its phases if an undesirable waste of time is to be avoided.

H. L. SCHULTZ
Assistant Superintendent of Maintenance
The Carborundum Company
Niagara Falls, N. Y.

IT IS admitted that a large part of a maintenance engineer's time is used to interview salesmen. That these interviews have some value also is admitted even though their worth cannot be figured in dollars and cents. I do not believe that a maintenance engineer could interview all salesmen and still give the necessary attention to his other duties. However, through proper planning he can interview those salesmen whom he believes will benefit him the most in his work.

Following is a plan that I am trying out: Each salesman states his name, the company he represents, and his product to our telephone operator. The operator then calls the maintenance engineer, or other executive asked for, and gives him this information. If interested he informs the operator that he will see the salesman. But, if he is not interested, he talks to the salesman on the telephone, explaining his reason.

I believe that each salesman should be allowed to tell his entire story; otherwise the engineer is tempted to jump at conclusions. I also find it a good policy to have all propositions submitted in writing because a clearer understanding and a permanent record of the subject are obtained by this method.

W. R. SIMPSON, *Plant Engineer*
Thermoid Rubber Company, Trenton, N. J.

I FIND it a pleasure to interview all salesmen who call on me for they have given me many worthwhile ideas on shop equipment. The up-to-the-minute salesman can tell you all about the products of other salesmen as well as his own. Such information enables the maintenance engineer to select the best possible equipment for his plant.

It frequently happens that the maintenance engineer is already familiar with the material that a salesman has to offer. I can recall an instance in which I surprised a salesman by telling him every detail of the switch he was showing me. I later explained that I had seen it advertised in a technical magazine. His switch was a good one of standard make, so I ordered a few. I also told him how he might improve the switch. He acted upon my advice and gave the idea to his company. This example shows how salesmen are adding constantly to their store of knowledge for the benefit of all prospects.

A maintenance engineer should be able to arrange his work so that he will have time to interview every salesman who calls upon him. It is probable that he has an assistant who can take his place in his other duties when such work conflicts with a salesman's call. I can recall but one time when I was unable to see a salesman, but I did see him the next time he called.

CHARLES R. DEANER, *Chief Electrician*
The Griswold Manufacturing Company, Erie, Pa.

Small Applications of Handling Equipment

For future publication readers are invited to submit pictures and descriptions of small applications of handling equipment at work in their plants

NUMEROUS articles have been published in recent years describing extensive materials-handling systems that embrace all departments of large industrial plants, automatically or semi-automatically transporting materials from their receipt in the raw state through manufacturing processes into the freight cars as finished products. Interesting and revealing though such articles have been with their explanations of selective devices for synchronizing the flow of material through the plants, it is a well-known fact that such systems are applicable only to the larger plants of industries that, because of the quantity, standardization, and nature of their products, are adapted excellently for the purpose.

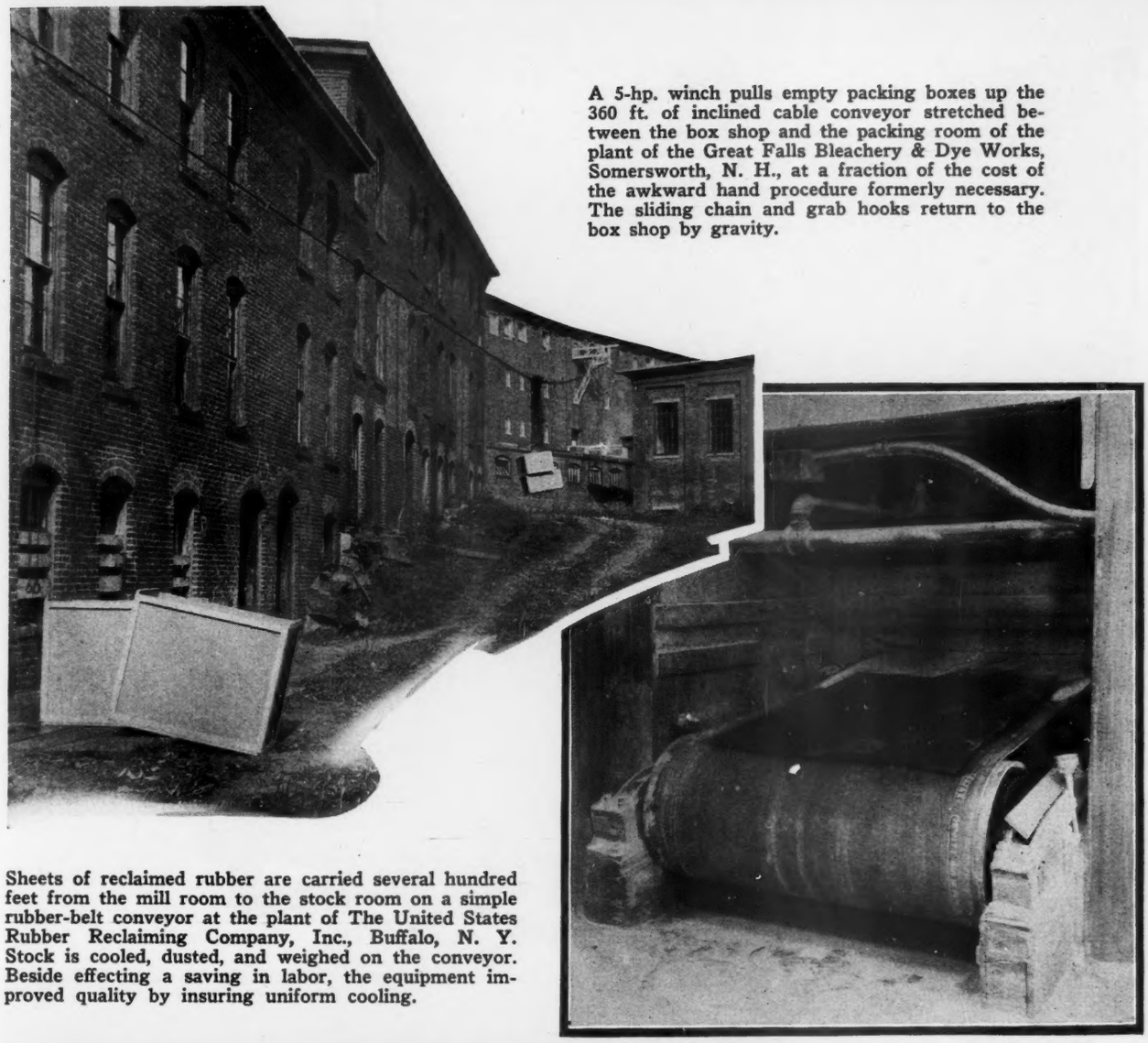
Applications of materials-handling equipment to plants not suited to such all-inclusive systems because of their moderate size, the nature and diversity of their products, or the physical limitations of their buildings, have received little attention either from technical publications or the literature of the equipment manufacturers. This condition exists in spite of the fact that the preponderance of American industry may be classified under such a heading.

Although a number of executives and engineers of the latter type of plants have utilized materials-handling equipment to the best of their ability wherever it justified itself economically, others have been under the conviction that, because their plants were not adapted to the installation of a complete system, they could use none.

The purpose of this series of articles is to do its bit in filling the need for further information on the small applications of materials-handling equipment by presenting illustrations and descriptions of such equipment efficiently at work in a wide variety of industries. It is predicted that the information will shed light on many hidden opportunities for sorely-needed economies in materials-handling costs.

It will be noted that the examples lean to the prosaic rather than the revolutionary or spectacular, but it was through the correct application of such commonplace principles that the plants derived the benefits herein described. The next instalment of the series will appear in an early issue.

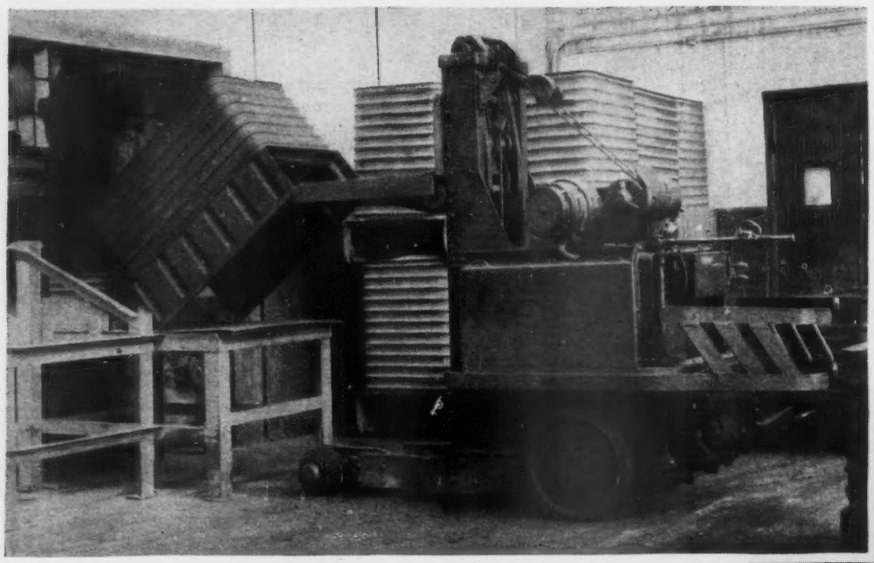
Conveyors and hoists don't fit into the picture of handling greeting cards in the plant of Hall Brothers, Inc., Kansas City, Mo. Instead, specially designed hand trucks are doing an economical job. The trucks were designed for economy of floor space with a maximum capacity for the service intended, ease in moving stock on and off the trucks, durability, and simplicity. Quiet operation is obtained by the use of rubber or fiber casters.



A 5-hp. winch pulls empty packing boxes up the 360 ft. of inclined cable conveyor stretched between the box shop and the packing room of the plant of the Great Falls Bleachery & Dye Works, Somersworth, N. H., at a fraction of the cost of the awkward hand procedure formerly necessary. The sliding chain and grab hooks return to the box shop by gravity.

Sheets of reclaimed rubber are carried several hundred feet from the mill room to the stock room on a simple rubber-belt conveyor at the plant of The United States Rubber Reclaiming Company, Inc., Buffalo, N. Y. Stock is cooled, dusted, and weighed on the conveyor. Beside effecting a saving in labor, the equipment improved quality by insuring uniform cooling.

Before the installation of the chain-type tray conveyor illustrated, it was necessary to use much valuable floor space to store sprayed parts in the plant of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Now the parts are carried up out of the way to the enameling oven as soon as they are sprayed.



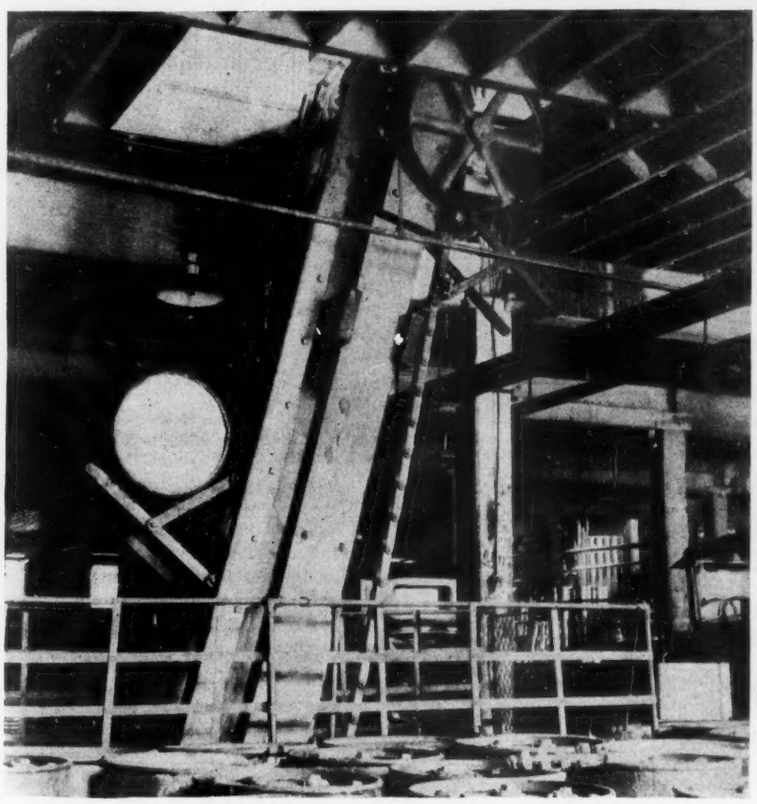
A tiering-type lift truck is a versatile tool in the plant of the J. H. Williams Company, Buffalo, N. Y. Beside its regular carrying, stacking, and lifting duties it is used frequently to empty loaded storage skids. The illustration shows the truck emptying a 2-ton load of rough forgings into a sand-blast barrel.

The force of gravity was put to work in carrying cases of lighting fixtures between the packing and shipping departments of the Benjamin Electric Company, Des Plaines, Ill. Halved indirect-labor costs of the two departments concerned followed the installation of the gravity roller conveyor shown.

Unloading heavy material piled loosely in freight cars is a hard, expensive job when done by hand. At the Hawthorne Works of the Western Electric Company, Chicago, Ill., such a problem was solved by the use of a portable rig equipped with an air hoist and pantograph-type grapple. The rig is moved about in the cars to stack copper bars on skids, which later are picked up by fork-type electric lift trucks.

A pull of the cord of the wire-line basket carrier shown sends reject girdles between inspection and cutting operations in the plant of the Spirella Company, Niagara Falls, N. Y. The equipment paid for itself in five months in reduction of material shortages.

The Maxweld Corporation, Brooklyn, N. Y., was able to multiply the capacity of its tank-storage yard by using a 3-ton electric crane-truck to stack its tanks. Paving the yard was not essential to the satisfactory operation of the truck.



Instead of the laborious, round-about hand methods formerly necessary, barrels of dry color now are hoisted directly from the receiving floor to storage on the floor above at the plant of the American Printing Ink Company, Chicago, Ill., by means of a special chain-type elevator. A 3-hp. motor driving the unit through three trains of gears supplies enough power to lift a 500-lb. barrel.

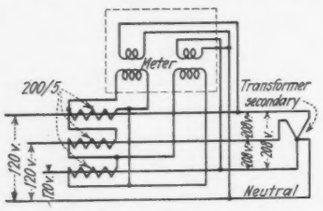
QUESTIONS and ANSWERS

Please submit answers promptly. We expect to publish no answers later than the second issue following the appearance of the question. Selection will be made on the basis of quality, but answers first received have the best chance of being used.

◆

Metering Three-Phase, Four-Wire System

The meter shown in the sketch is a two-element, 5-amp., 100-volt wattmeter connected to a three-phase, four-wire system. I wish that readers would tell me



(1) whether this meter will indicate correctly on unbalanced loads. (2) What multiplier should be used with this wattmeter? H. B. W.
Seattle, Wash.

■

Removing Rust from Machinery

We have tried without success to find some way of removing rust from our machinery, and keeping it from forming again. It is not possible to remove the rust by scraping or rubbing with abrasive cloth and then apply paint, and chemical rust removers have not given satisfactory results. If any other readers have had this trouble and solved it, I wish they would tell me how they did it. W. P.
New York, N. Y.

■

How Take Down Sheet-Iron Smokestack?

It is necessary for us to remove a sheet-iron stack 36 in. in diameter and 90 ft. high, which we want to salvage for further use. We need information on the best method of procedure, and will appreciate it. J. E. K.
Newllano, La.

■

Heating Locomotive Tires Electrically

I understand that there is some method of heating locomotive tires electrically, in order to apply or remove them. Such a method would be interesting to us, and I wish that any reader who can give me information on it would do so. W. E. A.
Houston, Tex.

Removing Ventilating Fans from Armature Shafts

I should like to know (1) the method that readers have found to be the most practical for removing the small stamped or cast ventilating fans from the end of an armature, preparatory to rewinding. (2) When rewinding d.c. field poles should poles of opposite polarity be obtained by reversing the leads when connecting up the winding, or by reversing the direction of the winding on the pole? G. A. L.
Brooklyn, N. Y.

MOST fan assemblies are a shrink fit on the shaft; others are a driving fit with a tapered pin driven through the fan hub and shaft. Some motors have fans that are driven on to a knurled section of the shaft.

To remove the fan, first drive out the tapered pin, if one is used. Then place two substantial strips of metal under the hub of the fan and support their ends so that a few smart blows with a rawhide mallet on the end of the shaft will drive it through the fan. If the fan cannot be moved in this way direct the flame of a blowtorch against the hub to expand it slightly.

By all means wind all coils for a d.c. field pole job identically. When winding sleeve each beginning lead with white sleeving and each finish lead with black sleeving. If this is done, when the coils are ready to be connected the winder will not have to trace out the direction of the winding.
Denver, Colo. CARL A. WAGNER

SMALL fans and shields used on fractional-horsepower motors may be removed safely by using the die bar shown in Fig. 1. These bars may be made from scraps of bar steel of various thicknesses. If preferred several pairs of bars with only one hole may be used.

Supporting bars are not necessary, however, as almost anything that will support the fan so that the shaft can be driven through it will answer the purpose, although better results will be obtained by the use of bars made for that purpose. If the fan sticks the hub should be heated for a moment with a torch to expand it. If the fan is made of aluminum it is advisable to heat it in an oven. When heating aluminum with a torch care must be used not to get it too hot. Before trying to force a fan from the shaft, always be sure to ascertain whether it

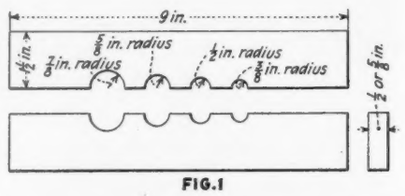


Fig. 1—Supporting bars for removing fans from small motor shafts.

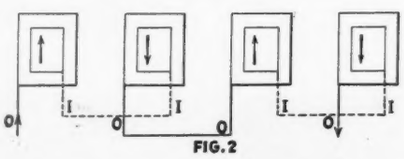
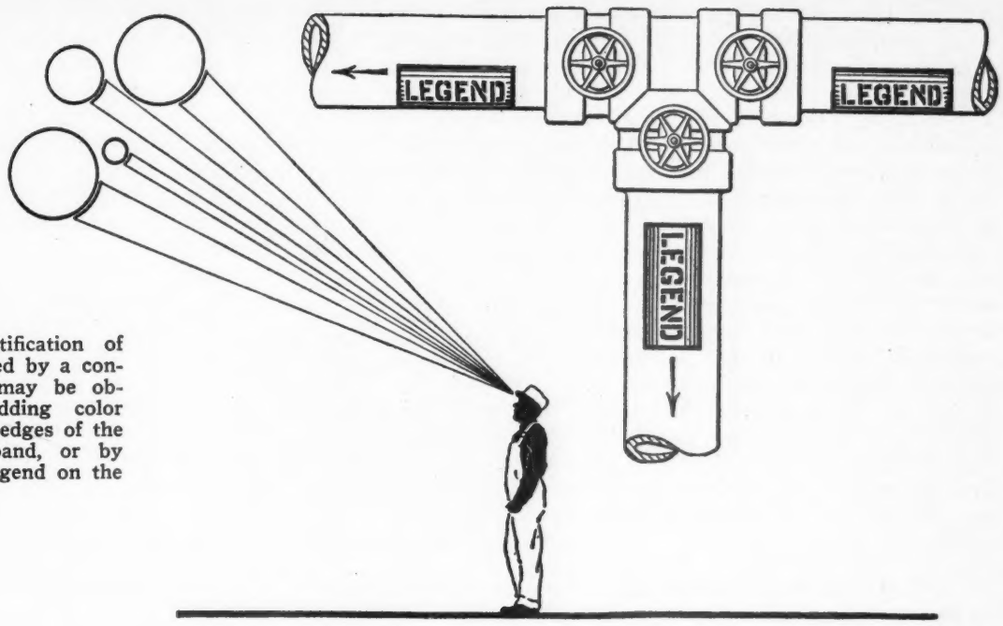


Fig. 2—Method of marking leads of d.c. field coils to facilitate connection.

is held in place by setscrews or a pin. If a fan cannot be removed without breakage it is best to wind the armature with the fan in place.

In Fig. 2 is shown the method of connecting a four-pole d.c. motor field. The outside leads are marked "O" and the inside leads "I," the term "inside" designating the lead next to the core when the field is installed on the pole-piece. Almost always I wind the fields for a motor all alike, starting and ending all leads at identical points on the coils. Fields are placed in the motor with the marked lead on either the right or the left, when facing the side on which the leads are brought out. When connecting, all like leads are tied together, as shown. If the circuit begins on an "O" lead it will end with an "O" lead. The two adjacent fields will tie together with "I" leads, the next with "O"s, and so on.

GRADY H. EMERSON
Birmingham, Ala.



Detailed identification of material carried by a conduit system may be obtained by adding color stripes at the edges of the main color band, or by stenciling a legend on the main band.

Standard Identification of Piping Systems

JOHN GAILLARD
Mechanical Engineer
American Standards Association
New York, N. Y.

IN A RECENT article[1], the use of identification colors on pipes and conduits was advocated as a safety measure and as a means of facilitating maintenance of the piping and conduit system. This suggestion was made, according to the author's statement, "in the absence of a standard color scheme for the identification of pipes and conduits carrying the plant's various services." There exists, however, a national standard scheme for the identification of piping systems intended to serve as the general basis for color identification systems adopted by individual plants or branches of industry. This scheme was developed some years ago under the procedure of the American Standards Association (ASA) and under the joint sponsorship of the National Safety Council and the American Society of Mechanical Engineers. It was approved by the ASA as American Recommended Practice[2].

Pipes are defined as conduits for the transport of gases, liquids, semi-liquids, or plastics, but not of solids carried in air or gas. Pipes buried in the ground, and electric conduits, are not includede in this scheme.

The standard scheme is based on the general principle that the pipes of a specific system shall be color marked so as to indicate, first of all, to which of five major classes of materials their contents belong. This marking also tells whether the material concerned is safe or unsafe. The five classes are listed below, together with their respective characteristic colors and letter symbols:

F—Fire protection material—Red.
D—Dangerous material—Yellqw.
S—Safe material—Green.
P—Protective material — Bright blue.
V—Extra valuable material—Deep purple.

The basic color may be applied over the entire length of the piping system, or in bands 8 to 10 in. wide placed at intervals throughout the piping system, preferably near valves and other important places. More detailed identification of the material carried by a system may be obtained either by adding color stripes at the edges of the main color band, or by stenciling letters, words, or figures on the main band. These additional stripes or stenciled marks should be decided upon by the individual plant concerned.

There are two main reasons why a general scheme of identification, employing colors, cannot be worked out to cover all materials carried by pipes in any plant. First, no sufficient variety of readily distinguishable colors is available to be applied to the large number of materials involved. Second, only few pigments, when applied on piping, will stand up well enough under practical conditions of use and exposure to be considered as permanent. Moreover most of the colors that do stand up are high priced and not always readily available.

1. **Coded Pipes and Conduits Lessen Plant Hazards**, by R. W. Spears, *Maintenance Engineering*, p. 236, May, 1931.

2. **Identification of Piping Systems—A13, 1928**; copy may be obtained for 50 cents from ASA, 29 West 39th St., New York, N. Y.

It will be clear, however, that the main purpose—the securing of safety—is effectively attained wherever the standard scheme is applied. For example, if fire protection lines in all plants in this country were marked by the color red, so that all men working in such plants could have become accustomed to this color indication, there would be practically no danger of a combustible or explosive liquid being erroneously directed upon a fire. However, such a fatal error might—or very probably would—happen if gasoline pipe lines were painted red, as suggested in the article referred to, and a workman or watchman, newly transferred from a plant that has adopted the American standard scheme, were to attempt fighting a fire.

Classification of Materials

The *fire protection* class includes the fluid in sprinkler systems and other fire fighting equipment.

Dangerous materials are defined as those that "are in themselves hazardous to life or property by virtue of being easily ignited, or productive of poisonous gases, or are in themselves poisonous. They include materials that are known ordinarily as fire producers and explosives."

Safe materials are "those which involve no hazard in their handling and which are of no extraordinarily high value. A workman in approaching a piping system to make repairs will accordingly run no undue risks in breaking into a pipe bearing a safe material, even though that material had not been emptied by previous arrangement."

Protective materials are those that "are piped through plants for the express purposes of being available to prevent or minimize the hazard of the dangerous materials above mentioned. Thus, a plant may have certain special gases which are antidotes to poisonous fumes piped through its shops for the express purpose of release in case of danger."

Extra valuable materials "might be classified with the group of the safe materials above mentioned, but where these products have a very high value, it is preferable to give them a separate major classification."

Choice of Colors

Red has been chosen for fire protection equipment because of long-established custom. Yellow or orange has been assigned to dangerous materials because of the high visibility of each under poor conditions of illumination. Moreover, yellow as a color suggesting the exercise of caution is conventional in the quarantine flag of ships and in railroad signals. The three other colors have been chosen in the natural sequence of their appearanc in the spectrum: green, blue, and purple.

Providing a Company Standard

The standard scheme gives specific instructions for its use as a basis for setting up a more detailed standard color scheme for an individual plant, as follows:

1. List all materials carried in the pipes of the system or systems.
2. Assign each of these materials to one of the five main classes referred to above.
3. Group the materials assigned to each class for the purpose of facilitating the selection of sub-class markings.
4. Choose between the alternative methods of using color bands or of painting the pipes completely in an identifying color.
5. Assign a legend or color stripe to each material listed under each main classification.
6. Refer to the list of colors for special applications (given in an appendix of the standard) and select the five color paints that will identify the main classes and the paints to be used for the stripes, if stripes have been decided upon.

Classification Problems

Some materials have the peculiarity of being dangerous in one case and safe in another. For example, ammonia, usually a dangerous material, is a safe one when used for attacking phosgene fumes. Should its conduits be identified by yellow in the former case, and by green in the latter? Obviously, such variation in identification might lead to confusion. The committee that developed the standard therefore decided that the rule should be "once a dangerous material, always a dangerous material," and that in the exceptional cases where a usually dangerous material becomes a safe or protective one, special markings, other than color, should be used so to designate it.

There are also cases where a material that is usually safe becomes dangerous: for example, water over quicklime. According to the standard, the material should be classified as a safe one, but danger markings applied to the locations where it is dangerous. Similarly, it is recommended that fire outlets taken from a drinking or service water system be marked in red, but the remainder of the system in green (safe material).

Specific materials—The standard lists about sixty different materials carried in pipes, each with the class to which it belongs. Most of the materials belong to the "dangerous" class (acetylene gas, chlorine, mercury, steam above atmospheric pressure, and the like). Among the safe materials are carbon tetrachloride, cold soda ash solution, steam below atmospheric pressure, cold turpentine, and so on. As a valuable material, lactic acid is mentioned.

Trade standards—In order to show how the Ameriacn standard may be used as a basis for a more detailed standard applying to a specific plant or industry, a color scheme is given for the identification of piping in paper and pulp mills. Water conduits are sub-divided here into fifteen kinds, some of which are designated simply by the green color for a safe material, while others are identified by additional color stripes, such as black stripes for boiler feed water lines and return condensate water lines, and brown stripes for blow-off conduits.

Colored pigments—Fourteen colored pigments suitable for standard identification colors, and reasonably fast under changes in plant atmosphere, are listed in the standard. The resistance of each pigment against acidic, alkalinic, or sulphureted vapors or liquids, is described. The list, which does not pretend to be exhaustive, is meant to serve as a guide in dealing with the more usual types of abnormal exposure conditions.

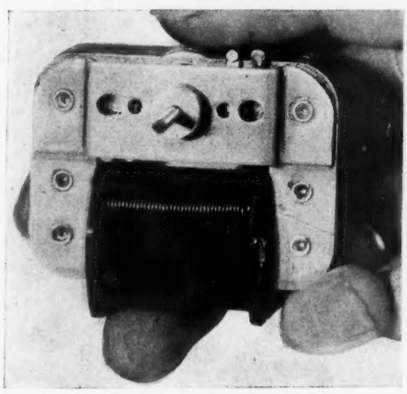
Legends—Detailed recommendations are given for the use of legends—stenciled letters or figures—on the main color bands. These legends should consist mainly of the name, perhaps abbreviated, of the material carried in the pipe line. An arrow may be added if the direction of the flow is important. Further recommendations concern the position of the legend, the size of its lettering, and the like, with a view to good visibility from the operating floor, platform, or balcony.

EQUIPMENT NEWS

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these devices, which are designed to improve plant operation or reduce operating and maintenance costs.

Barber-Colman Fractional-Horsepower A.C. Motors

SMALL fractional-horsepower a.c. motors have been announced by the Barber-Colman Company, Rockford, Ill. They are furnished for either unidirectional or reversible rotation, for any voltage between 10 and 230, and for frequencies from 25 to 60 cycles. Special two-speed models also can be furnished. The motors are constructed of steel laminations, brass bearing plates, oilless bearings, and squirrel-cage rotors upon hardened shafts. All coils are wound on phenolic-resin spools and are impregnated to exclude moisture and insure good insulation. Advantages claimed



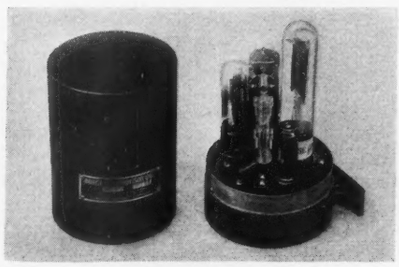
are small size with relatively high power output, quiet operation, and absence of interference to radio reception. The motors are used in electric fans, heat regulators, moving-picture projectors, unit heaters, and other applications requiring high starting torque and small size.

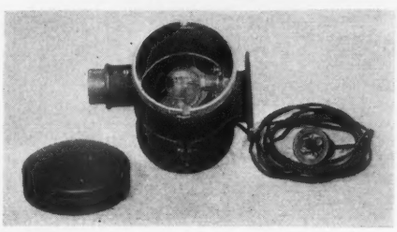
■

Burgess Light-Relay and Light-Source Units

LIGHT-RELAY and light-source units have been announced by the Radiovisor Division of the Burgess Battery Company, 202 East 44th St., New York, N. Y. The units are designed around the Radiovisor Bridge or light-sensitive cell. Both units are available for a wide range of light-control applications.

Light-relay units are available in





both a.c. and d.c. models for use on all common power supplies. Each unit is in the form of an aluminum housing with a window which contains a circular platform on which the bridge, tubes, and other components are mounted. The a.c. unit consists of a bridge, two 427-type tubes serving as an amplifier and a rectifier respectively, a power transformer, a filter condenser, resistors, by-pass condensers, and a power relay. The d.c. unit is comprised of a bridge, one 427-type tube serving as an amplifier, voltage-reducing and other resistors, a by-pass condenser, and a power relay. The unit housing is held in place by a wall-bracket ring and is designed to permit the adjustments necessary to line up the window with the actuating light source. When provided with a vacuum contact, the light relay can control a circuit handling up to 1,320 watts.

The light-source units also are available in a.c. and d.c. models. Each unit contains a 12-volt, 21-cp. bulb and a focusing optical system to concentrate the light beam on the light-sensitive surface of the light-relay unit. The light-source unit also is housed in an aluminum case.

■

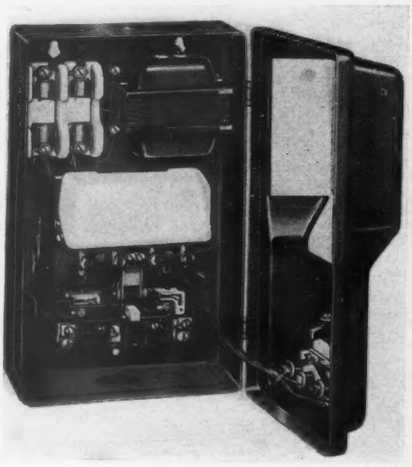
Masonite Cushioned Flooring

WOOD flooring designed to take the jolts out of walking has been announced by the Masonite Corporation, Chicago, Ill. The flooring, which is of tongue-and-groove construction, consists of outer layers of tempered "Presdwood" and an inner layer of "Quartrboard." The latter layer acts as a shock absorber and sound deadener. It comes in three sizes in the form of 6-, 9-, and 12-in. squares; it is reversible and is light in color on one side and dark on the other. Border strips, 3, 6, and 12 in. wide and 47 in. long, also are furnished. The squares can be placed on cement or wood underflooring and may be either glued or nailed in place. Many designs and flooring effects are possible by varying the various sizes and colors of the tiles. The material can be used either as sub- or top flooring.

■

Allen-Bradley Motor Switches with Low-Voltage Control Circuits

ANNOUNCEMENT is made by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis., that its a.c., across-the-line motor switches now are available with step-down control transformers for reducing the control-circuit voltage to 110 volts when the switches are used on 440- or 550-volt circuits. The transformer, which is of the separate-winding type, derives its power from the regular power circuit and is mounted inside the switch cabinet. Each motor is protected against sustained overloads by two "Resistotherm" overload relays which can be reset outside the cabinet. The switch, known as the Bulletin 709T, is used principally where

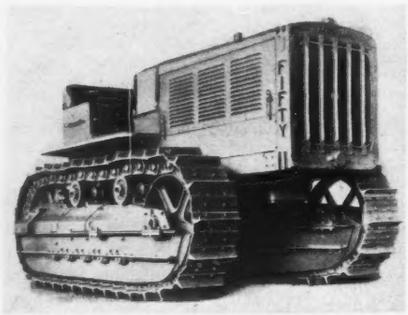


a pilot-control device, such as a pressure switch, thermostat, or pushbutton, is limited to low-voltage application. The maximum rating of the switch is 7½ hp. Three forms are available: Form 1 has a "start and stop" pushbutton station in the cover; Form 2 is not equipped with pushbuttons; and Form 3 has a three-way lever switch provided with automatic "off" and "hand" positions.

■

Caterpillar "Fifty" Tractor

ADDITION of the "Fifty" model, which develops 50 drawbar hp., to its line of tractors has been announced by the Caterpillar Tractor Company, Peoria, Ill. The machine is of the same general design and appearance as the rest of the line and includes such advantages as a hood inclosure for the engine, fuel tank located behind the engine, and a cushioned driver's seat. A four-cylinder, four-cycle, water-cooled,

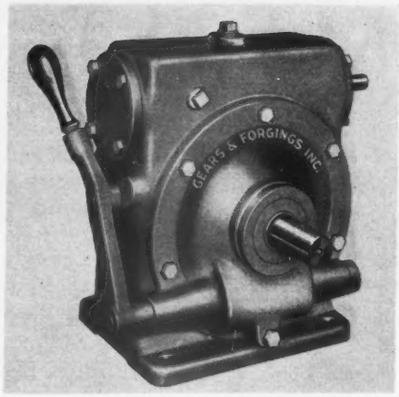


valve-in-head gasoline engine is standard equipment. The tractor is 16,500 lb. in weight.

■

Gears and Forgings Two-Speed Worm-Gear Reducer

A TWO-SPEED, worm-gear reduction unit, designed for either horizontal or vertical drives from ⅛ hp. up, has been introduced by Gears and Forgings, Inc., Cleveland, Ohio. The reducer is manufactured in types either integral with the motor or as a separate reduction unit and in speed reduction ratios ranging from 4:1 to 150:1. The unit consists of a worm and worm gear, a set of differential gears, driving shafts equipped with roller bearings, and a housing. The two speeds are obtained by means of the differential gearing. The high speed is obtained by moving the small hand lever to the right. This movement locks the differential to the low-speed shaft on which the worm gear and differential gearing rotate as one unit. Movement of the hand lever to the left locks the side

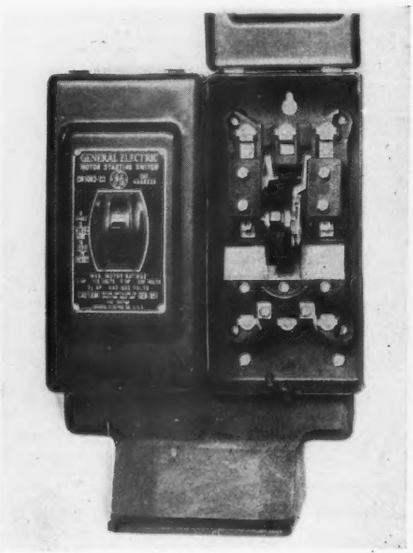


gear of the differential, preventing its rotation. Thus one-half of the revolutions of the worm gear are imparted to the slow-speed shaft. Speed changes can be made while the unit is in operation under full load.

■

General Electric Motor-Starting Switch

GENERAL Electric Company, Schenectady, N. Y., announces a motor-starting switch, known as CR-1062-C2, that is designed especially for use with general-purpose motors. The switch is of the three-pole type with double-break, silver umbrella-shape contacts. Molded arc chutes supporting the movable contacts totally inclose the contact tips and arcs. The contacts are reported to reduce arcs to a minimum even when under maximum load or when the motor rotor is stalled. The thermal overload relays are of the solder-film, ratchet type and are inclosed to prevent damage to the switch from short circuit. Relay heaters are built into molded cases which have protective sides to safeguard them from mechanical injury.

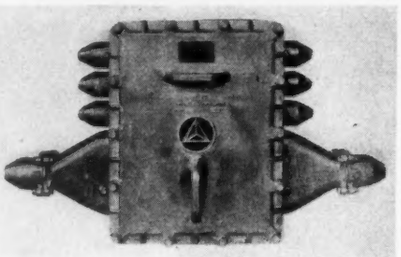


The operating mechanism has a snap action and trips free on overloads. If an overload operates to trip the switch, all three poles will open it. The switch also protects the motor against single phasing. The mechanism within the switch is positive so that vibration will not cause the switch to trip. The switch is totally inclosed in a drawn-shell cover and fabricated case, which resist a high percentage of the moisture usually prevalent in textile mills. The cover can be swung up 180 deg. to provide access to the interior. The cover is supplied with a positive spring catch with a locking feature so that the switch may be opened easily or locked positively. The molded switch handle is marked with "on" and "off" and is operated from the front of the case. Holes are provided in the guards for locking the switch in the "off" position.

■

Delta-Star Cable-Junction Box

AN ALUMINUM-ALLOY, cable-junction box with maximum clearances and leakage distances has been developed by the Delta-Star Electric Company, 2400 Block, Fulton St., Chi-



cago, Ill. Conductors for each circuit are brought into the box on equidistant centers. Single-conductor heads interchange with multi-conductor heads, and any head can be installed anywhere along the side of the box. The bus unit with molded insulation can be used on four-, six-, or eight-way boxes. Cable-socket bushings and connectors are the same on single or multi-conductor heads. Links are made in interchangeable and removable halves.

■

Square D Manual Starter

INDUSTRIAL Controller Division of the Square D Company, 710 South Third St., Milwaukee, Wis., announces a manual three-pole starter, known as Class 2510 W5, designed to control across-the-line single and polyphase motors of 2 hp. or less. Although especially adapted to fan, blower, pump, air-compressor, machine-tool, and loom installations, the starter is suitable for

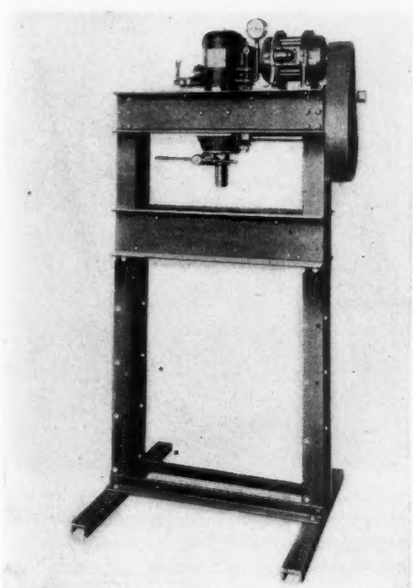
general applications in which remote control and low-voltage protection are not essential.

Overload protection is provided by time-limit thermal relays, which reset from the front and require no replacement of parts after operation. Tripping of one relay opens all three lines. The starter is arranged for wall or pedestal mounting and push-button operation. It is approximately $4\frac{1}{2}$ in. wide, $7\frac{1}{4}$ in. high, and $3\frac{3}{4}$ in. deep.

■

Hannifin-Vickers Hydraulic Presses

GENERAL utility hydraulic presses, designated Hannifin-Vickers, have been announced by the Hannifin Manufacturing Company, 621 South Kolmar Ave., Chicago, Ill. The machines are available in 20-, 40-, or 60-ton sizes, and in hand-operated or motor-driven types. All parts of the operating mechanism—the cylinder, pump, valves and reservoir—are combined in an integral unit. Although regularly furnished with

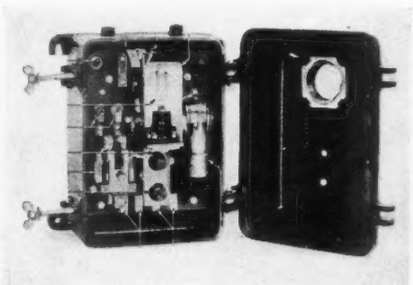


frame construction as illustrated, units are available without the complete power unit. Standard frames are constructed so that the motor drive can be added later.

■

General Electric Photo-Electric Controller

A PHOTO-ELECTRIC controller designated 'Novalux" has been developed by the General Electric Company, Schenectady, N. Y. The unit, which responds to variations in daylight intensity, controls street lighting circuits, floodlight installations, electric signs, and other types of outdoor lighting equipment. A weatherproof case incloses a photo-electric cell, a vacuum tube, contactors, and time-delay relays. The latter prevent instantaneous operation due to momentary intensity variations. The unit may be adjusted to close the external circuit at any light



intensity from 1 to 10 foot candles, and to open the external circuit at any intensity from $1\frac{1}{2}$ to 4 times that necessary to close it. Close adjustment of the operating light intensity is secured by means of sensitive potentiometers.

■

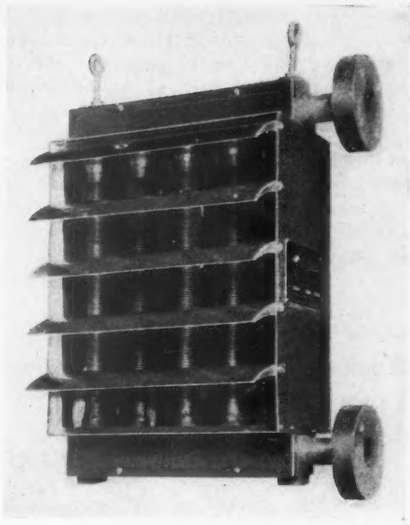
Correction on Trumbull Switches

IN THE October issue of *Maintenance Engineering* the illustration accompanying the equipment-news item entitled "Trumbull Front-Operated Safety Switches" on page 524 should have appeared in place of the illustration shown with the equipment-news item "Trumbull Range and Meter Service Switch" on page 527, and vice versa.

■

Niagara Disk Fan Heater

ALL ALUMINUM welded construction to protect the unit from corrosion features the disk fan heater announced by the Niagara Blower Company, 6 East 45th St., New York, N. Y.



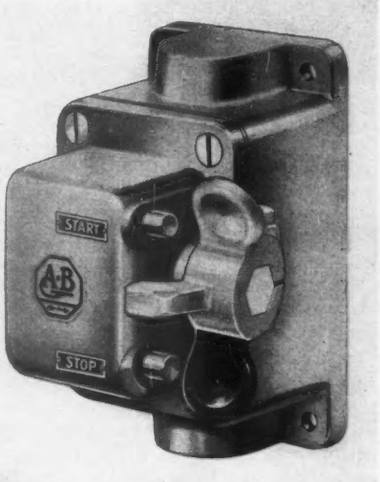
The unit is equipped with vertical tubes to expedite drainage. Heaters are available in standard sizes and ratings and are good for 150-lb. per sq. in. steam pressure.

■

Allen-Bradley Pilot Control Stations

WATERTIGHT, explosion-proof, pushbutton control stations with levers for operation by finger, hand, foot, rope, or shipper rod have been developed by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis. The stations contain pushbutton mechanisms for either standard- or heavy-duty service and are inclosed by cadmium-plated, cast-iron boxes tapped for $\frac{3}{4}$-in. conduit. Rubber gaskets exclude water and gases. Each cover and box are machined to provide an explosion-proof seal without gaskets.

The units are designed for use in dairies, laundries, dye plants, chemical plants, and other locations where pre-

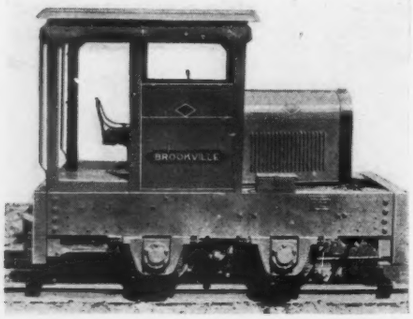


cautions must be taken to exclude liquid and moisture and where inflammable gases are likely to be present. They may be provided with a single button for two-wire pilot control or with two buttons for three-wire pilot control. "Start-stop," "forward-reverse," "up-down," and other designations can be put on the station covers to indicate the operation performed by each movement of the lever.

■

Brookville Gasoline Locomotive

BROOKVILLE Locomotive Company, Brookville, Pa., announces a locomotive equipped with a Ford Model AA gasoline power plant. Features are dual-spring, journal wheel suspension; steel tires; four speeds and reverse; governor control for motor protection; air



cleaner for carburetor; Timken bearings; and a self starter. The locomotives are available in 2-, 2½-, 3-, 3½-, and 4-ton weights for any gage of track.

■

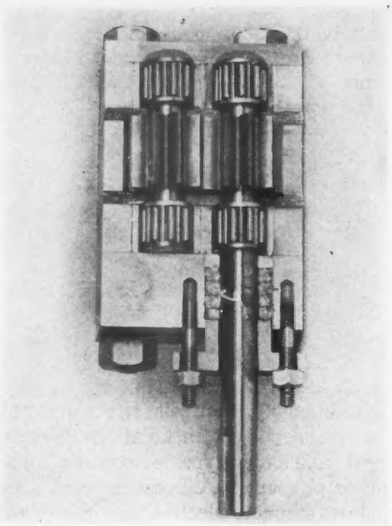
Toledo Synthetic Products "Plaskon"

"PLASKON" is the name of a heat-reactive, resinous molding compound announced by Toledo Synthetic Products, Inc., Toledo, Ohio. The compound was developed to produce a material with a high speed of cure that could be preformed easily.

■

Northern XD Rotary Pumps

SERIES XD rotary pumps, ranging in capacity from 1 to 15 gal. per min., have been announced by the Northern Pump Company, Minneapolis, Minn. Two types of bearing construction are available—"Nitralloy" and roller bearings. The former are recommended when such liquids as fuel oil, gas oil, coolant, or any other liquids with little or no lubricating value are to be

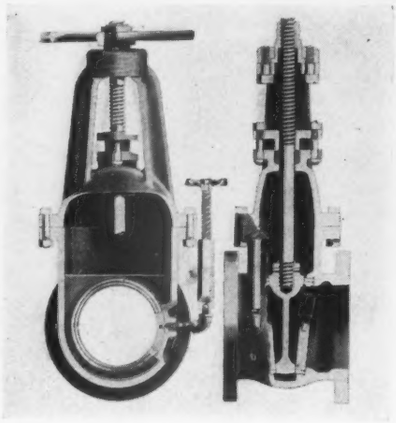


pumped. Roller bearings are recommended when the pump is to handle clean lubricating oil. The pumps are adapted especially for use in connection with hydraulic hoists, lifts, dump trucks, stokers, cranes, conveyors, and machine tools.

■

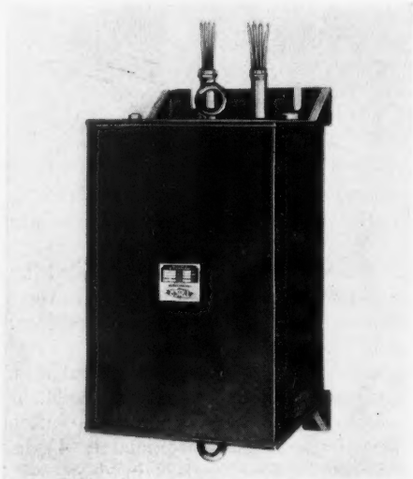
Reading-Pratt & Cady "Lubrotite" Gate Valve

READING-PRATT & Cady Company, Inc., Bridgeport, Conn., announces the "Lubrotite" gate valve for general industrial use. It embodies in its construction a duct system for introducing a lubricant-seal between the seating surfaces. The valve is reported to be sealed tight even though the seating surfaces have become damaged by scratches, deposits, or corrosion in the line. The lubricant seal separates the wedge from the seats slightly so that wedges that have become set from a long period of service are freed easily. The unit is recommended for boiler feed-water, boiler blow-off, water-system, chemical-line, and paper-mill applications. The valves are made in standard and extra-heavy iron-body patterns, and in electric cast steel.



Trico Transformers

TRICO FUSE MANUFACTURING COMPANY, Milwaukee, Wis., announces a line of air-cooled insulating and auto transformers in capacities ranging from ¼ to 50 kva. All sizes are approved by the Underwriters' Laboratories. The transformers are totally inclosed and are provided with

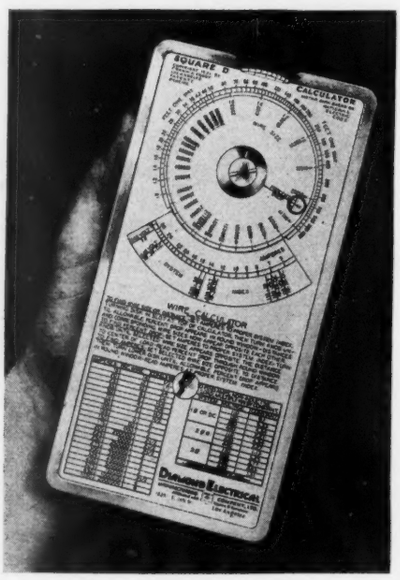


mounting brackets and conduit connections. Special sizes and booster transformers are available on special order.

■

Square D Calculator

DIAMOND Electrical Manufacturing Company, Ltd., 1320 East 16th St., Los Angeles, Calif., affiliated with the Square D Company, Detroit, Mich.,



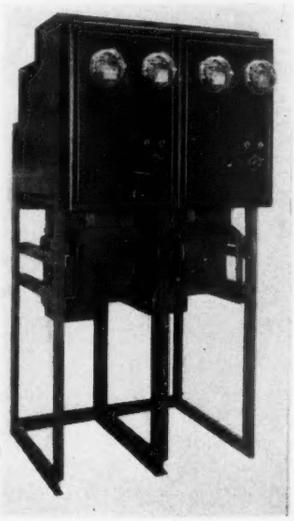
announces the Square D calculator designed for the rapid computation of electric-wiring and motor data. When the calculator is used for solving in-

terior and conduit wiring problems, it will figure any one of four items—amp., ft. of wire, size of wire, and percentage drop. From the motor calculator dial can be obtained the size of circuit switch, size of starting fuse, size of conduit, size of wire, necessary running protection, and full-load amp. for any of the three principal types of 220- or 440-volt, three-phase motors.

■

Delta-Star Metal-Clad Switchgear

DELTA-STAR Electric Company, 2400 Block, Fulton St., Chicago, Ill., has developed a totally inclosed switchgear for 7.5-kv. service in which the solenoid- or motor-operated oil circuit breakers can be lowered and removed by a truck. Interlocks prevent removal or insertion of the breaker terminals into the disconnecting plug switches until the breakers are in the



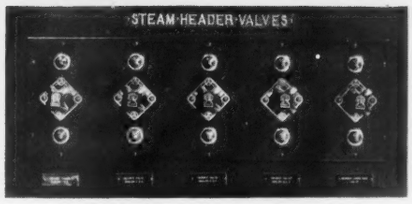
open position. Calibrating-relay terminals, indicating lamps, and a control switch are mounted on the front panels, back of which are the bus compartments. The unit is dust and vermin proof.

■

Delta-Star Station Auxiliary Control

DELTA-STAR ELECTRIC COMPANY, 2400 Block, Fulton Street, Chicago, Ill., has developed a control panel for circuit breakers used with motor-driven station auxiliaries. The panel can be mounted in steel boxes or on switchboard panels.

The control switches are made with normally open contacts, with turn handles, or with pull-button auxiliary contacts, as dictated by the conditions to be met. Any combination of position-indicating lamps can be supplied to show the breaker contact in position.



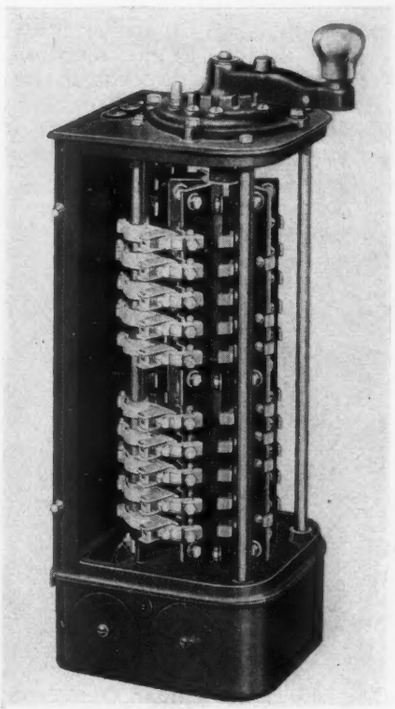
Wiring is facilitated by double terminals, and card-holders on the bakelite contact housing simplifying circuit tracing.

■

Allen-Bradley Drum Controller for Multi-Speed Motors

BULLETIN 365 drum controllers for use with multi-speed squirrel-cage motors have been developed by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis. The units are designed for reversing and non-reversing service with motors having two, three, or four speeds, of either the separate-winding or consequent-pole-winding type, and for variable-torque, constant-torque, or constant-horsepower applications. The range of sizes is sufficient to take care of two- and three-phase motors up to 30 hp., 220 volts, and 60 hp., 440-550 volts. Speeds are selected by a horizontal hand lever.

Up to and including the 5-hp. rating, the controllers can switch the motor current directly on the drum contacts. Controllers above that rating are to be used with magnetic across-the-line switches or motor starters for switching the primary current each time the speed-selecting lever is moved to a new position. The "start" and "stop" button station in the large-size controllers also

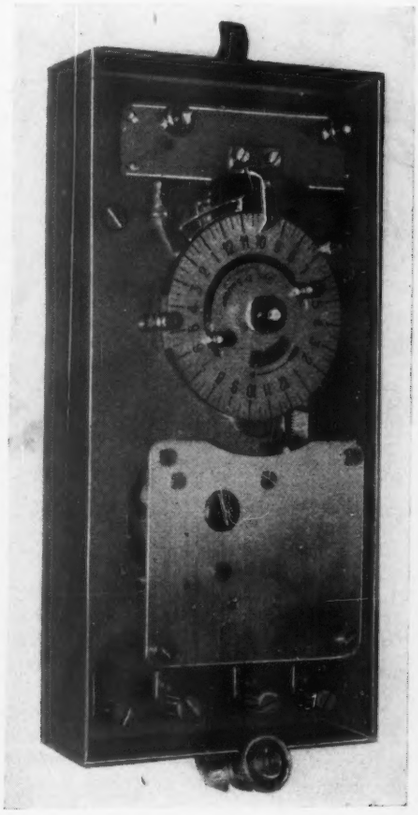


allows the motor to be stopped and started without changing the setting of the lever. Controllers rated at 5 hp. or below can be supplied in skeleton form, without a cabinet, for mounting in any individual motorized machine. Contact fingers are self-aligning, non-stubbing, and adjustable.

■

Cramer "Sauter" Synchronous-Motor Time Switch

FEATURING the "Sauter" time switch, announced by R. W. Cramer & Company, Inc., 67 Irving Place, New York, N. Y., is a self-starting, slow-speed, synchronous motor. Each motor is designed to operate at a certain speed in exact time with the frequency from the generating station. Therefore any number of the time switches used to control street lighting,



sign and store-window lighting, off-peak water heating, or other time-controlled circuits are turned on or off at precisely the same time.

The switch is equipped with laminated copper contacts with silver arcing tips. Units can be furnished in 2-, 10-, 15-, and 25-amp. capacities for 110 or 220 volts. The synchronous motor is for use on 110-volt, 60-cycle circuits. Every switch is mounted in a pressed-steel housing with convenient knockouts for conduit connections. It may be had with an astronomic dial to control automatically the operating time in step

with the change of sunset and sunrise throughout the year. A standard spring-driven clock can be interchanged with the self-starting, synchronous-motor clock.

■

Byers Wrought-Iron Sheets

A. M. BYERS Company, Pittsburgh, Pa., announces that it now is manufacturing wrought-iron sheets for use as roofing and siding. The rolled sheets are available in any standard thickness between 10 and 28 gage, in widths up to 38 in., and in lengths up to 144 inches.

■

Bodine Vertical Motors

BODINE Electric Company, 2264 West Ohio St., Chicago, Ill., announces that, owing to the construction

of brackets of N-5 wool-packed bearing motors, they may be provided in vertical- or flanged-mounted models to meet requirements. Umbrella covers are optional on the installations.

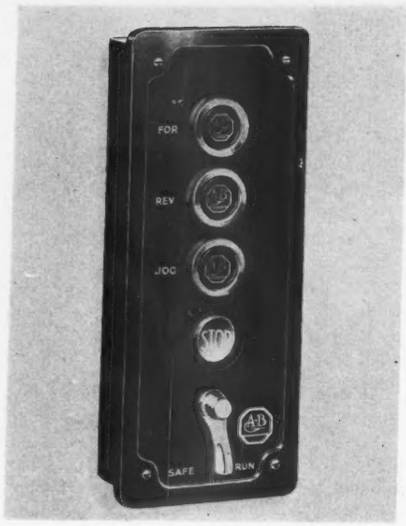
These motors are available in ratings of 1/10 and $\frac{1}{8}$ hp. at 1,725 r.p.m. and 1/20 and $\frac{1}{12}$ hp. at 1,125 revolutions per minute.

■

Allen-Bradley Motor-Control Stations

ANNOUNCEMENT is made by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis., that its line of Bulletin 800 push-button control stations has been augmented by the addition of four-button and five-button stations.

The Type N-1060 series of four-button stations have three running buttons, giving three motor speeds, and one "stop" button. The stations are used extensively with automatic switches for three-speed motors of the multi-speed, squirrel-cage type. The addition of a two-way lever switch to the above stations converts them into the Type N-1090 series of four-button stations.



The five-button stations, known as the Type N-1080 series, are designed for use with four-speed, multi-speed motors to give four running speeds and one "stop."

■

Schwenk Carboy Tilter

SCHWENK Safety Device Corporation, 27 Water St., New York, N. Y., announces a device, known as a carboy tilter, that is designed to enable one man to handle and drain carboys of liquids with safety. A carboy is elevated into the tilter by an arrangement of levers. It is supported on three sides and the bottom when in position within the carboy box. When the device is used to drain a carboy every drop can be removed from the bottle.

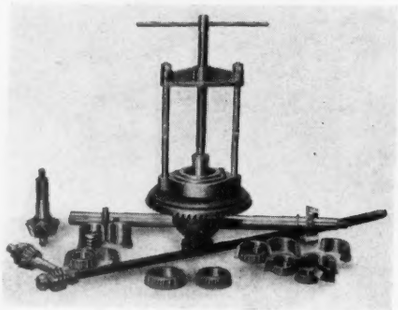
Newark Protected-Bottom Strainer

A REMOVABLE-BOTTOM strainer for the paint, varnish, and lacquer industries has been announced by the Newark Wire Cloth Company, Newark, N. J. A clamp adjustment loosens the old cloth and a reverse operation clamps the new cloth in place on a galvanized-iron frame. The lower rim serves as a guard to protect the bottom of the strainer. The frame is 5 in. deep with rolled top and bottom edges. Stock sizes are 12, 16, 18, and 20 in. in diameter.

■

Curtiss & Smith Universal Dismounting Press

ROLLER, ball, or other anti-friction bearings; gears; pulleys; disks; collars; or bushings can be removed from equipment without damage by use of the Universal dismounting press announced by the Curtiss & Smith Manufacturing Corporation, 245 South St., Newark, N. J. To remove a part the proper chuck or adapter is attached to the press, and the press screw is turned until the part is dislodged. Presses are available in several standard sizes and designs with chucks and adapters to suit the pieces to be dismounted.



■

Electro Metallurgical "Cromansil" Steel

"CROMANSIL" is the name given to a series of low-alloy steels containing chromium, manganese, and silicon that have been announced by the Electro Metallurgical Company, 205 East 42nd St., New York, N. Y. The most useful forms of the steel contain from 0.4 to 0.6 per cent chromium, 1.1 to 1.4 per cent manganese, and 0.7 and 0.8 per cent silicon, with a carbon content ranging from less than 0.10 to 0.65 per cent depending upon the specific use to which the steel is to be put. The steel can be used as rolled or in the heat-treated condition. By selection of appropriate alloy percentages it is generally possible to obtain the desired

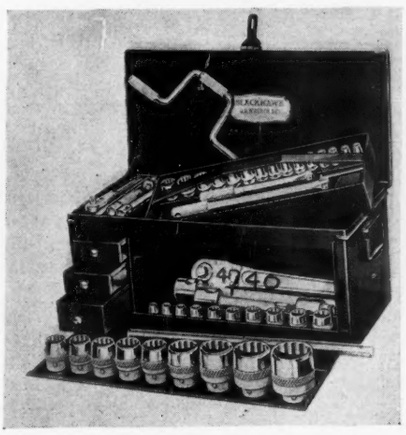
physical properties without heat treatment. A simple normalizing may be employed with or without subsequent tempering.

A few of the applications in which this type of steel is especially advantageous are ship plates and naval structural parts; bridges and buildings where a high strength-weight ratio is desired; chimneys; penstocks; pressure vessels; tanks; and boilers.

■

Blackhawk 48 WD Wrench Set

BLACKHAWK Manufacturing Company, Milwaukee, Wis., announces the 48 WD wrench set designed to meet the needs of millwright, maintenance, and mining work. All socket wrenches in the set are equipped with "Lock-On" drives which prevent the sockets from slipping off accidentally. This feature

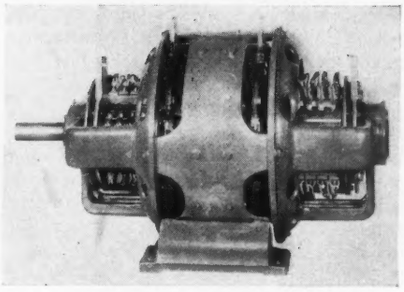


provides safety during such overhead work as repairing cranes, mounting motors, and other tasks in which injury might result from the falling of heavy tools. Double-hexagon and double-square sockets are provided to accommodate all nuts, bolts, and cap screws of the U.S., S.A.E., and new American Standards ranging from $\frac{1}{4}$ to $1\frac{1}{2}$ in. in size. An assortment of handles, extensions, ratchets, and speeders provides handy working combinations for a variety of jobs. The tools are packed in a chest provided with a drop front, a removable tray, three pull drawers, and a fixed tray. The case also provides room for extra equipment, such as pliers and hammers.

■

Columbia Electroplating Generators

COLUMBIA Electric Manufacturing Company, 1292 East 53d St., Cleveland, Ohio, announces a line of 100- to 15,000-amp., low-voltage electroplating generators. The machines are available



with single or double commutators. They may be shunt or compound wound and self or separately excited. Other features include Timken roller bearings, welded-steel frames, and bracket bearing construction.

■

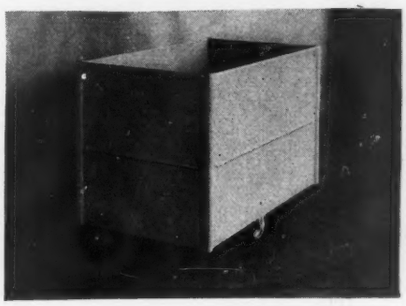
Pease "Kyano" Process for Developing Blueprints

ANNOUNCEMENT of a process for developing blueprints reported to eliminate the running of blues into whites has been made by The C. F. Pease Company, 813 North Franklin St., Chicago, Ill. By the use of this method, known as the "Kyano" process, blueprints can be made simultaneously with blue-line prints, and "blocking out" avoided. The process permits the use of fast-printing papers and is said to reproduce tracing lines accurately in their full width. In addition to a blueprinting machine the necessary equipment consists of a chemical furnished in pulverized form, a 10-gal. solution tank, and a process attachment equipped with a pump.

■

Clark Steel-Box Trucks

WELDED, steel-box hand trucks, known as "Smooth Edge," have been announced by The George P. Clark Company, Windsor Locks, Conn. The top edge and corners are turned down and rounded. Rigid or swivel casters can be provided with rubber-, canvas-, fiber-, or aluminum-tired wheels in plain or ball-bearing types. Four or six casters in any desired arrangement may be furnished with each truck. The

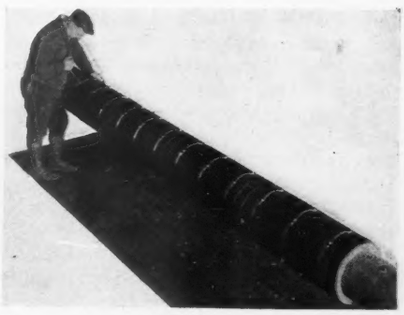


smallest of the four sizes now available is 36 in. long, 18 in. wide, and 24 in. deep in inside dimensions; the largest is 48 in. long, 30 in. wide, and 30 in. deep.

■

Adsco Insulation Support

TO CORRECT misalignment and distortion of pipe insulation the American District Steam Company, North Tonawanda, N. Y., has developed an insulation support designed to hold the pipe covering concentric with the pipe. When the support is installed on covered pipe, the covering is cradled in brass bands. Each band is hung from a saddle which passes through the insulation and rests directly



on the upper surface of the pipe. Supports are available to suit standard pipe up to 24 in. in size, as well as $1\frac{1}{2}$-, 2-, and 3-in. pipe covering.

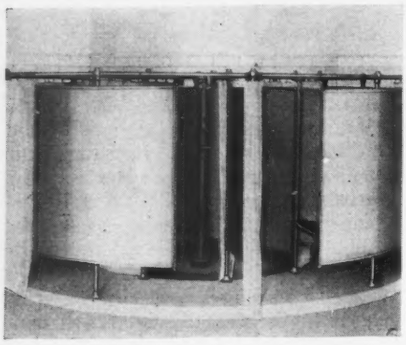
■

Cutler-Hammer Across-the-Line Starter

CUTLER-HAMMER, INC., 253 North 12th St., Milwaukee, Wis., announces the redesign of its Bulletin 9115 three- and four-pole, across-the-line, manual starters to incorporate thermal overload relays in place of the thermal overload cutouts formerly supplied. The relay provides features that were not obtainable with the thermal cutout. Should an overload occur that may be dangerous to the motor, the overload relay trips, opening two lines to the motor so that the entire circuit is opened. When tripped, the operating handle is returned to the full "off" position which resets the overload relay, so that the motor can be started again. A trip indicator in the cover of the inclosing case shows at a glance whether the overload relay has been tripped. The starter also has a redesigned cover interlock which prevents opening the inclosing case when the motor is running, and permits locking of the operating lever and the inclosing-case cover in the "off" position.

Bradley Shower-Room Fixture

BRADLEY Washfountain Company, Milwaukee, Wis., announces a circular shower- and dressing-room combination. The fixture is composed of



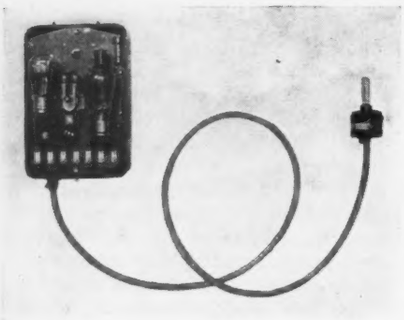
five shower compartments located in the central portion of the circle and ten dressing rooms that divide equally the remaining area. With this arrangement one person can be dressing or undressing while another is using the shower. Only three plumbing connections—two supplies and one drain—are required for the entire fixture. Partitions are of enameled steel, and the framework is constructed of wrought-iron pipe. The standard color is artillery grey. Shower heads, control valves, and soap trays are of chromium-plated brass. Dressing rooms are equipped with clothes hooks and wooden seats.

■

General Electric High-Speed Photoelectric Relay

A HIGH-SPEED photoelectric relay, designated CR-7505-G-5, has been introduced by the General Electric Company, Schenectady, N. Y., as an addition to its line of electron-tube control equipment. The device finds application in those operations where high-speed operation is essential. Among the suggested uses are the rapid sorting, selecting, or registration of objects; high-speed counting; and other applications in which the time for response is too short for the use of a mechanical type of relay operating on a small amount of current.

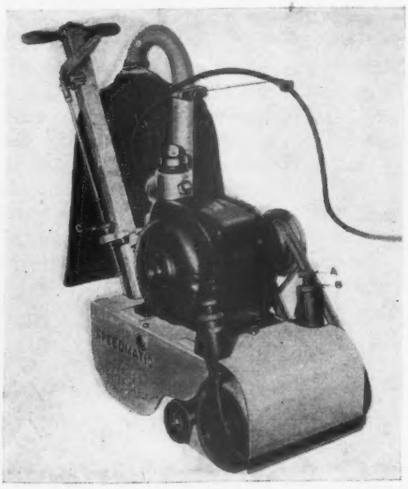
Three electron tubes are used: a photoelectric tube which picks up the light impulse and produces a corresponding electric impulse; a Pliotron tube which amplifies the electric impulse produced by the photoelectric tube; and a Thyratron tube which acts as a relay, producing timed impulses for the operation of electric devices. A small contactor may be built into the device when it is necessary to control currents in excess of the rating of the Thyratron tube. The relay is built for operation on 110-volt, 60-cycle circuits.



■

Porter-Cable-Hutchinson Floor Surfacer

PORTER-CABLE-HUTCHINSON Corporation, Syracuse, N. Y., announces a floor surfacer, known as the "Speedmatic" Type FF-12, that features an adjustable, suspended drum. The bracket within which the drum is mounted is suspended from the main frame by two arms. By turning the two thumb screws located on top of the bracket, the drum may be adjusted to

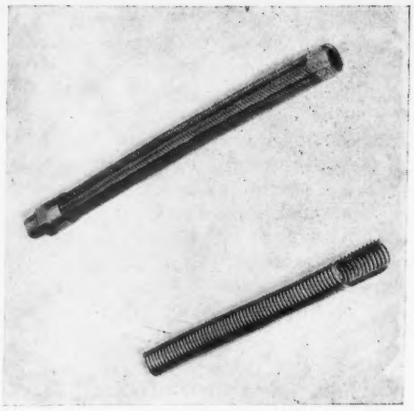


suit operating conditions. Also, by rotating the thumb screw attached to the control rod, any drum pressure may be obtained up to 99 lb. per sq.in. Other characteristics of the surfacer are a 1½-hp. ball bearing motor; V-belt drive; removable fan assembly; one-piece, cast steel chassis; and precision type ball bearings. The duralumin drum is 7½ in. in diameter and is covered with sponge rubber. The drum revolves at 1375 r.p.m. under 50 lb. per sq.in. of pressure.

■

Bendix Flexible Metallic Tubing

SEAMLESS, flexible metallic tubing has been announced by the Bendix Stromberg Carburetor Company, South Bend, Ind. It consists essentially of



alloyed bronze tubing corrugated in round-thread, deep-wall form. Fittings are brazed or welded to the tubing. The tubing can be furnished for pressures as high as 6,000 lb. per sq.in. and for temperatures up to 500 deg. F. To suit various conditions the cable is armored with bronze or steel braid, or a protective casing.

■

Cutler-Hammer Electric Space Heater

CUTLER-HAMMER, Inc., 253 North 12th St., Milwaukee, Wis., announces the Bulletin 15510 electric space heater. Its heating element is composed of a nickel-chromium alloy, and a highly refractory granular compound is used for insulation. The element is imbedded in the compound under pressure, which feature is reported to make the heater immune from the effects of vibration and jarring. Normal rated capacity is 500 watts. Heaters are furnished for 100- to 125- and 200- to 250-volt, d.c. or a.c. power supply. High overload capacity protects the units from voltage peaks. The heaters may be used in crane cabs, watchmen's houses, small isolated offices, and other places where it is uneconomical to extend the central heating system.

■

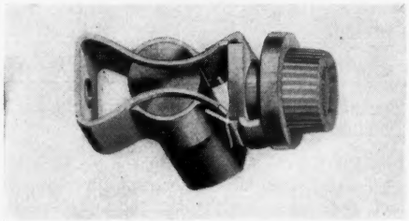
Fairfield Skip Hoists and Loaders

FAIRFIELD Engineering Company, Marion, Ohio, announces that it now manufactures a complete line of skip hoists and accompanying equipment. The skip hoists are available in capacities of from 4 to 300 tons per hr. with bucket sizes ranging from 10 to 150 cu.ft., and with bucket speeds ranging from 50 to 300 ft. per min. The machines are built with unbalanced-, counterweighted-, or balanced-type buckets, and with automatic or semi-automatic control.

Two types of skip loaders also are available—a weight-operated type automatically controlled by material weight and a bucket-operated type designed for general-purpose work.

Ideal Fuse Clip Clamps

IDEAL COMMUTATOR DRESSER COMPANY, Sycamore, Ill., announces a line of fuse clip clamps. They are used to hold fuses in positive con-



tact. The clip clamps are available in three common sizes for fuses up to 60 amp., 600 volts in rating.

■

Morse Roller Chain

MORSE Chain Company, Ithaca, N. Y., announces the development of a roller chain designed to insure uniformity of pitch throughout the life of the chain. Within each roller are two joint members—a segmental bushing and a pin. The cross-section of the pin is that of a round pin integral with a segmental bushing. Owing to this construction, when the chain is flexing on a sprocket, all sliding movement of surfaces under load is between the pins and their bushings or, in other words, no movement under load occurs between the rollers and the joint members. The open spaces between the joining members provide reservoirs for oil. Flexure of joints is reported to introduce a pumping action that expedites lubrication. The chain is made in all standard sizes and is interchangeable on all standard roller sprockets.

■

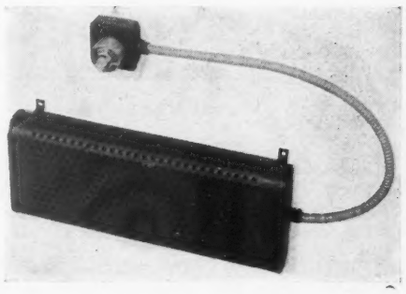
Inland Steel Floor Plate

INLAND STEEL COMPANY, Chicago, Ill., announces that it now is producing a four-way floor plate. In pattern the plate consists of short lineal projections arranged alternately at right angles to each other. This design gives the plate non-skid qualities regardless of the direction of traffic. Individual plates can be laid in any relation to each other without altering the design. The pattern also expedites drainage and sweeping.

■

General Electric Air Heaters

FIVE ratings of horizontal, electric air heaters for industrial applications have been announced by the General Electric Company, Schenectady, N. Y., as follows: 1,000 watts at 115 volts; and 1,000, 2,000, 3,000 and 4,500 watts at 230 volts. The units consist of a number of strip heaters mounted in black-japanned, perforated, pressed-steel

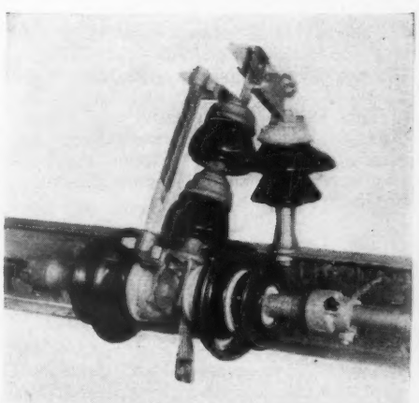


cases. Each unit is equipped with 3 ft. of armored cable and a three-heat snap switch mounted on a standard conduit box. Heaters are designed for either wall or floor mounting.

■

Delta-Star Remote-Control Switch Unit

DELTA-STAR ELECTRIC COMPANY, 2400 Block, Fulton St., Chicago, Ill., has developed a single-pole, remote-control, fused switching



unit. It can be interlocked mechanically with other units to form multiple assemblies. The units are especially adaptable for use in protecting small-capacity, single- or three-phase transformer banks rated from 4.5 to 23 kva. The switches are furnished for use with several types of fuses.

■

Clark Tructractor Power Sweeper

A POWER sweeper for cleaning terminals, warehouses, sidewalks, and paved yards has been announced by the Clark Tructractor Company, Battle Creek, Mich. It will clean at the rate of 42,000 sq.ft. per hr. and will handle light snow. The sweeper is shown mounted on a gasoline-powered "Tructractor." A 60-in. broom cleans a path 52 in. wide. The position of the broom may be adjusted to sweep at any desired angle. The broom also can be lowered, raised, or stopped at will by the operator. In high gear the equipment has a speed of 7½ m.p.h., but best results are obtained at a speed of 2 m.p.h. When not in operation the broom is carried 6 in. above the ground. The equipment can be provided with a generator and head and tail lights for night work. When required a sprinkler tank may be mounted on the rear.

Kester Solder Opens Canadian Plant

KESTER SOLDER COMPANY, Chicago, Ill., announces the opening of a plant at Brantford, Ont., Canada, under the name of Kester Solder Company of Canada, Limited.

TRADE LITERATURE

For copies, address the manufacturers concerned

■

(392) MATERIALS HANDLING — Catalog, 32 pages, slings, prices, tables, and general information. — Macwhite Company, Kenosha, Wis.

(393) ELECTRICAL EQUIPMENT — Leaflet 20044-F, Type LD group-type capacitor equipment for power-factor correction on 60-cycle circuits. — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(394) POWER TRANSMISSION—Leaflet, 4 pages, "Tuplex," "Simplex," and "Marine" flexible couplings.—Clark Coupling Company, 149 Church St., New York, N. Y.

(395) POWER TRANSMISSION—Leaflet L 20520, Westinghouse-Wise multi-speed drive.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(396) FIRE PROTECTION — Bulletin, 4 pages, "Removing Conflagration Breeders." —National Fire Protection Association, 60 Batterymarch St., Boston, Mass.

(397) AIR CONDITIONING—Abstract No. 1, 8 pages, principles and engineering data and specifications on air conditioning.—Niagara Blower Company, Buffalo, N. Y.

(398) RAILWAY EQUIPMENT — Booklet GEA — 1463, automatic switchgear and associated supervisory systems for railway service.—General Electric Company, Schenectady, N. Y.

(399) LIGHTING—Bulletin GEA—1299A, "Novalux" ornamental floodlighting luminaires.—General Electric Company, Schenectady, N. Y.

(400) GENERATORS—Leaflet GEA—1483, 4 pages, medium-speed a.c. generators, Types ATB and ATI, 7500 and 7600 Series, 60 cycles.—General Electric Company, Schenectady, N. Y.

(401) MOTORS — Leaflet GEA—2460, 4 pages, Type TS and QS, 7500 Series, general-purpose synchronous motors.—General Electric Company, Schenectady, N. Y.

(402) MOTORS—Leaflet GEA—560B, 4 pages, Type SCR constant-speed single-phase motors.—General Electric Company, Schenectady, N. Y.

(403) MOTORS — Leaflet GEA—1475, 4 pages, Type SCR single-phase vertical motors.—General Electric Company, Schenectady, N. Y.

(404) INSULATION—Leaflet GEA—318D, 4 pages, insulator units for outdoor devices.—General Electric Company, Schenectady, N. Y.

(405) INSULATION—Bulletin 10-A, 30-pages, Rockbestos insulated electric wires and cables.—Rockbestos Products Corporation, New Haven, Conn.

(406) HEATING — Bulletin C-108, 16 pages, Chromolox electric air heaters.—Edwin L. Wiegand Company, 7500 Thomas Blvd., Pittsburgh, Pa.

(407) POWER TRANSMISSION — Bulletin R-50, 16 pages, Morse roller chain drives. —Morse Chain Company, Ithaca, N. Y.

(408) WELDING—Leaflet Amsco nickel manganese steel welding rods.—American Manganese Steel Company, 389 E. 14th St., Chicago Heights, Ill.

(409) POWER PUMPS — Specification sheet D-412-S6, horizontal-duplex piston pattern for general service.—Worthington Pump and Machinery Corporation, Harrison, N. J.

(410) LIGHTING—Booklet "Ultra-Violet for Everyone," 32 pages, a comprehensive treatise on the subject of ultra-violet, describing in detail the technical and general features of Mazda sunlight lamps as well as their application.—Printed and distributed jointly by eighteen manufacturers of lighting equipment of this type.

(411) ELECTRIC MAGNETS—Bulletin 125, 12 pages, "The Story of Ohio Separation Magnets."—The Ohio Electric Manufacturing Company, Cleveland, Ohio.

(412) INVENTORY—Booklet, "How to Take Inventory in a Manufacturing Plant," 32 pages.—The Barrett Bindery Company, 1332 W. Monroe St., Chicago, Ill.

(413) MATERIALS HANDLING — Catalog 15, descriptions and illustrations of the complete line of Wright hoisting and conveying equipment.—Wright Manufacturing Company, Bridgeport, Conn.

(414) SAFETY — Pamphlet 74, "Safety Contests—Competition as an Aid in Promoting Accident Prevention." — National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill.

(415) INDUSTRIAL COMMUNICATION — Catalog 1503, 16 pages, Strowger manual telephone switchboard parts.—Automatic Electric, Inc., 1033 W. Van Buren St., Chicago, Ill.

(416) PIPE FITTINGS—Bulletin GEA-940-B, 16 pages, panel and benchboard pipe fittings.—General Electric Company, Schenectady, N. Y.

(417) ELECTRICAL EQUIPMENT—Bulletin 38-T, distribution connectors for copper and aluminum conductors, hot line clamps and insulated sticks.—Delta-Star Electric Company, 2400 Block, Fulton Street, Chicago, Ill.

(418) PUMPS—Bulletin, 4 pages, Amsco type "C" materials handling pumps. — American Manganese Steel Company, 389 E. 14th Street, Chicago Heights, Ill.

(419) RUBBER GOODS—Folder No. 19 of series, Republic air hose.—The Republic Rubber Company, Youngstown, Ohio.

(420) VENTILATION—General ventilating catalog, 14 pages, design and construction of the "Paragon" fan.—The American Propeller Company, Division of Bendix Aviation Corporation, South Bend, Ind.

(421) FLOORING — Bulletin, 8 pages, "Evanite" wood block flooring.—National Wood Products Company, 3300 Union Guardian Building, Detroit, Mich.

(422) ELECTRICAL INSTRUMENTS—Bulletin 4324, "S and H" Type Z measuring bridge.—Herman H. Sticht & Company, 15 Park Row, New York, N. Y.

(423) MOTORS—Bulletin 210, 4 pages, Type T two-pole Reliance motors.—Reliance Electric & Engineering Company, Ivanhoe Road, Cleveland, Ohio.

(424) ELECTRIC FURNACES — Bulletin GEA-11468, 24 pages, direct heat, metallic resistor, electric furnaces.—General Electric Company, Schenectady, N. Y.

(425) MOTORS — Leaflet 20516, single phase motors.—Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

(426) SIGNALING SYSTEM — Circular 1522, 4 pages, the Strowger police supervisory and recall system. — Automatic Electric, Inc., 1033 W. Van Buren Street, Chicago, Ill.

(427) SPRAY PAINTING—Catalog, complete descriptions and prices of spray painting outfits for general use. — The DeVilbiss Company, Toledo, Ohio.

(428) OIL BURNERS—Catalog, 32 pages, illustrations and details of improved types of oil burners.—Enterprise Oil Burner Company, 2902 19th St., San Francisco, Calif.

(429) POWER TRANSMISSION — Catalog 99, the complete line of Reeves variable speed transmissions.—Reeves Pulley Company, Columbus, Ind.

(430) POWER TRANSMISSION — Catalog M-101, 36 pages, individual motor drives and power transmission appliances.—Hertzler & Zook Company, Belleville, Pa.

COMING EVENTS

Seventh Annual Conference on Welding—To be held by the Engineering Extension Department of Purdue University at Lafayette, Ind., Dec. 10-11. Professor in charge, W. A. Knapp, Purdue University, Lafayette, Ind.

Second International Heating and Ventilating Exposition—In conjunction with the American Engineers and the American Society of Refrigerating Engineers, Cleveland, Ohio, January 25 to 29, 1932. The exposition is under the direction of the International Exposition Company, Grand Central Palace, 46th St. and Lexington Ave., New York, N. Y.

MAINTENANCE ENGINEERING'S DATA SHEETS

Safe Practices for Materials Storage

Oils — Acids — Dry Materials

(Continued from the November issue)

Acid Storage

Tanks and Vats—Where acid is received in tank cars and stored in quantities, it is well to have the storage tank located above ground. When it is underground, the storage tank should be placed in a substantial concrete- or brick-lined pit, the walls of which are far enough away from the tank to allow access for complete inspection. The pit should be kept free from water, especially where acids that react with water are stored. Where the liquid is forced by compressed air from the storage tanks to various points in the plant through pipe lines, all acid pipe lines, joints, valves, connections, tanks, and other containers should be inspected regularly, and leaks should be repaired at once. Pumps are more satisfactory than compressed air for moving acid in pipe lines.

Before starting a repair job, workers should be equipped properly with masks and other protective devices. Acid and air valves should be closed and locked, the pipe or container should be drained, and sufficient time allowed to permit all gas to escape. In opening an acid line, the above directions first should be followed, and then a lead shield should be laid over the flanges to protect the operator in case the acid spurts. The two bottom bolts of the flanges are removed, and the remaining bolts loosened gently until the acid starts to drip. If the flanges do not part readily, a small wedge may be used. The wedge should be made of some non-sparking metal. The lead shield should have a hole in it large enough to admit the wedge. When air is used to force chemicals out of containers, the air line should be equipped with a pressure gage, a pressure-reducing valve, and a safety valve set to blow off at a pressure under the safe maximum working pressure of the container. Care must be exercised in soldering or performing other work requiring the use of an open flame.

Every tank used for the storage of chemicals should be installed so that, if the tank should rupture and the contents escape, the danger is minimized. The tank should be supported in such a way that leakage from any part of it will be noticed immediately. It should be covered with a protective paint to resist the corrosion from moisture, fumes, and other causes. It also is advisable to surround the tank with a pit, catch basin, or depression large enough to hold the entire contents of the tank in case of rupture. Although this provision will not prevent the formation of fumes it will, at least, localize the escaping liquid and prevent it from flowing into workrooms and other places where it would be dangerous. In some instances small containers of acids have been transported in basins containing a suitable neutralizer for the acid in case of breakage.

All open tanks or vats should be installed in such a way as to insure employees against falling into them. It is advisable to build the top of the vat at a height not less than 30 in. above the floor or standing level; otherwise a double handrail 42 in. high and, if the top of the tank or vat is flush with or below the level of the floor, a 6-in. toe-board should surround such a vat. Walkways should not cross over open vats or tanks but, where their construction is absolutely necessary, they should be equipped with substantial handrails and toe-boards.

The manufacturers of liquid chemicals advise against the use of compressed air in emptying acid containers, especially such containers as carboys and metal drums. Before filling, such containers usually are tested but for leakage only. Therefore, they are likely to rupture if subjected to more than 15-lb. per sq.in. pressure.

After a tank or vat has been emptied, it is not sufficient merely to wash it out with water. To remove fumes and remaining particles of acid the container, after being washed thoroughly with plenty of water, should be cleansed further with steam introduced under pressure by means of a hose. The hose should be directed against every part of the surface of the tank as though the metal were being washed with a stream of water. Care should be exercised in handling a steam hose to prevent the scalding of operators and workmen.

Some manufacturers prefer to wash out acid

MAINTENANCE ENGINEERING'S DATA SHEETS

Safe Practices for Materials Storage—Oils—Acids—Dry Materials

(Continued from the preceding page)

containers first with water and then with a neutralizing alkaline solution. In using this method, however, remember to give the containers a final washing with water.

Drums—Metal drums of various sizes are made of light sheet steel and hold from 500 to 1,500 lb. of chemical. They are best handled on rounded-bed trucks or trailers and usually are emptied by gravity or acid pumps, the latter method being preferred.

General—In many places it is advisable to provide tanks and acid-conveying apparatus with valves having extension stems or spindles passing to the outside of the building. This provision is made so that the valves can be closed without exposure to the fumes in cases of emergency.

Although strong sulphuric acid will not attack iron directly to any great extent, it often produces a molecular change that causes the inner layers of the metal to expand and, thereby, subjects the whole container to a tension which may be severe enough to cause rupture. Cases could be mentioned in which wide cracks have opened with explosive violence from this cause, allowing large quantities of acid to be ejected where men were working. Cast iron is more susceptible to this action than steel. Hence steel should be used, if possible, wherever strong sulphuric acid or its vapors are to be confined. Of course, this advice also applies to mixed acid. To guard further against such accidents pipe lines and other apparatus containing or conveying sulphuric acid should be surrounded by shields for the protection of men in all places where breakage might be attended with serious results.

The recommendations of the National Fire Protection Association for freeing tanks of flammable explosive vapors apply equally to acid tanks because of the many suffocating and explosive vapors generated in the movement of acids.

Many industries find it necessary to use open acid tanks. Such tanks should be lined with lead and have soldered or burned joints. It formerly was the practice to provide these tanks with circular hoops, but other types of construction have been found to be more satisfactory. A solid and satisfactory type of open lead-lined tank is constructed of 1x6-in. boards laid flat with ends alternating at the corners. Such a tank will not bulge or break under the pressure of large quantities of acid. It costs more than a hoop-bound tank, but it is more durable. In some cases this type of tank has given way to a tank of heavier construction, with boards and timbers on the long sides tenoned into the short sides for the entire height and the whole held together with steel bars. This is a very substantial method of construction.

Miscellaneous Storage Tanks—Without a doubt oils and acids are the most hazardous liquids stored in tanks. Other liquids commonly stored in tanks are water, brine, and caustic. Certain precautions are necessary regardless of the liquid handled.

The tank should be accessible for inspection. Stairways and ladders should enable anyone to get to any part of the tank for examination. Tanks on building roofs or on separate structures should be strong enough to withstand wind pressure and should be grounded effectively. The failure of a large tank often is disastrous because, even though there is no loss of life, property damage usually is extensive. The failures of sprinkler tanks on building roofs furnish other reminders of the hazards involved. Such a failure sometimes occurs because the tank supports have become weakened.

To provide easy access to tanks, stairways or permanent ladders should be constructed. Platforms are necessary where extensive repair work must be done. Both stairways and platforms should be provided with standard handrails maintained in good condition. All valves should be easily accessible from the platforms. If the floor of the platform is constructed of grating, it will facilitate the drainage of water and prevent the accumulation of dirt which otherwise might be hazardous.

(To be concluded)

Courtesy of National Safety Council

Link Belt's new line of self-aligning pillow blocks is Timken Bearing Equipped

After the long experience which the Link Belt Company have had with Timken Bearings, it was only natural that they should again turn to Timkens for anti-friction protection when designing their new self-aligning pillow blocks.

For in this equipment, as in all types of modern machinery, friction elimination is only part of the problem. Shafts must also be held in rigid alignment and protected against radial loads, thrust loads or any combination of both. That is a job for Timken tapered construction, and that is the reason why Timken is the dominant bearing in practically every industry.

No matter what kind of equipment you are buying, if you specify "Timken Bearing Equipped" you are assured of unusual power and lubricating economies, greater operating efficiency, longer life and lower maintenance. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* **BEARINGS**

INSURANCE PAYROLL EMPLOYEES WELFARE BREAKDOWNS COSTS UNEMPLOYMENT
MODERNIZATION INVESTMENT MARKETS PRICE
ACCIDENTS PRODUCTION
BUDGET INSPECTION ORDERS
QUALITY
REJECTS
SECONDS
SPEED
DELAYS INTERRUPTIONS
SHUT-DOWNS NEW MACHINERY

BETTER THAN DAYLIGHT

CLAMOR COMES ONE CLEAR VOICE . .

COOPER HEWITT ILLUMINATION

It's in times like these that the successful management of an industrial plant is put to the severest test. Every problem, big and little, connected with production presents itself for the most serious consideration—an all-round revaluation of values. And while next year's budget, new machinery, payroll, prices, costs and like problems now confront you—all clamoring for solution—there is one step you can take toward a better solution of them all.

A modern installation of mercury-vapor illumination is not, of course, a panacea for all industrial ills . . . but there is plenty of proof of its numerous economical advantages—attested by many of the nation's leading industrialists. Cooper Hewitt mercury-vapor light is today used in more than thirty different industries and is widely acknowledged to be *better than daylight.*

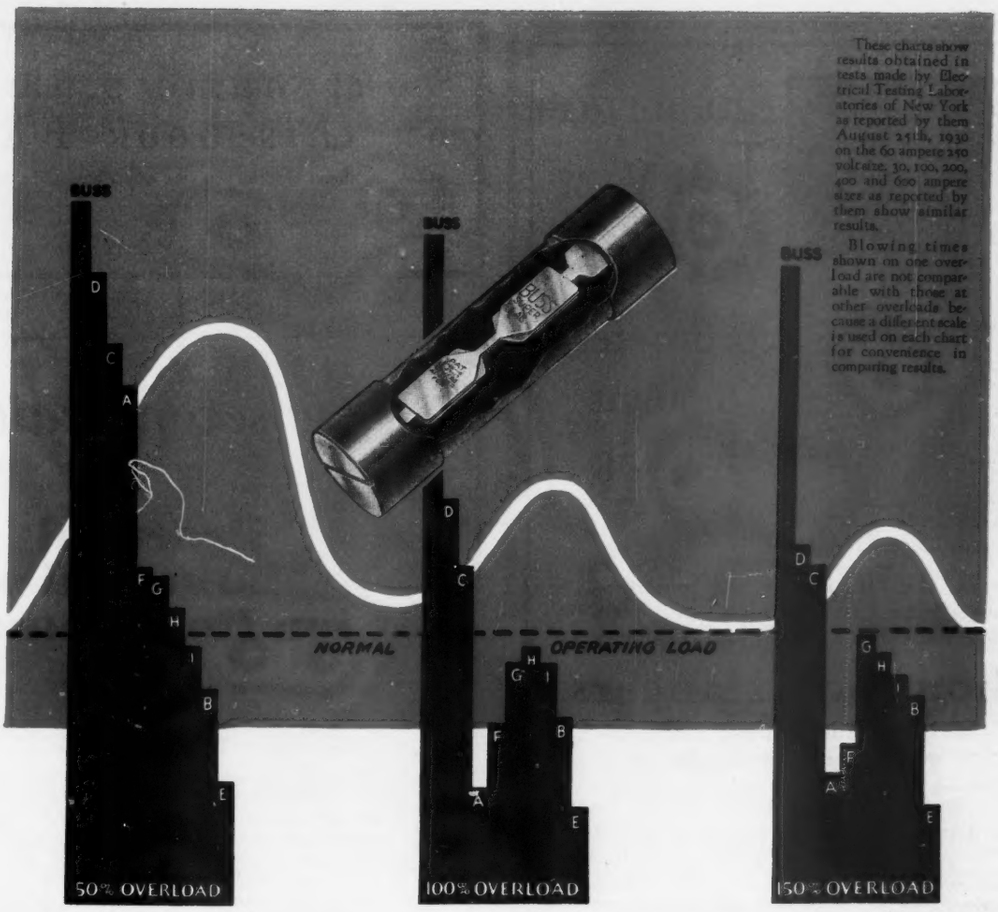
Cooper Hewitt light enables workmen to see better, work better and feel better —because it is a soft, cool light that reaches in and around and under all parts of a machine making the smallest details stand out sharply and clearly. It produces no glare from polished metal surfaces — nor does it create confusing dark shadows.

Thus Cooper Hewitt light speeds production and reduces waste. The scientific reasons back of these advantages are simply explained in the booklet, "Why Cooper Hewitt Light is Better than Daylight." A postcard will bring you a complimentary copy. General Electric Vapor Lamp Company, 817 Adams St., Hoboken, N. J.

GENERAL ELECTRIC VAPOR LAMP COMPANY

Join the "G-E Circle" every week-day noon, E. S. T. (except Saturday) and every Sunday at 5:30 P.M. N. B. C. Network of 54 stations.

509 © 1931, G. E. V. L. Co.


These charts show results obtained in tests made by Electrical Testing Laboratories of New York as reported by them August 25th, 1930 on the 60 ampere 250 volt size. 30, 100, 200, 400 and 600 ampere sizes as reported by them show similar results.
Blowing times shown on one overload are not comparable with those at other overloads because a different scale is used on each chart for convenience in comparing results.
BUSS
NORMAL OPERATING LOAD
50% OVERLOAD
100% OVERLOAD
150% OVERLOAD

REDUCE *the* WAGES
YOU PAY TO HARMLESS OVERLOADS

IF you are looking for places to **SLASH COSTS**—if you want to "stop leaks" and increase operating efficiency—why not "cut the overhead salary" you pay to harmless overloads that are the cause of many needless shutdowns.

You can't get away from temporary or harmless current surges—but **TODAY** you can prevent many of the **COSTLY SHUTDOWNS** often caused by them by using a **MODERN FUSE** that will "hold" where others fail.

Just glance at the chart—see for yourself how the **NEW BUSS SUPER-LAG** Renewable **FUSE** compares with old-fashion fuses. Here at last is a fuse that will blow **SAFELY** to protect equipment—yet has a time-lag long enough to carry many of those harmless overloads heretofore so difficult to combat.

Why continue to "pay wages to harmless overloads" that cripple production and wreck operating efficiency? Why not use a fuse that will help you keep machines running—lights glowing—workers busy—and overhead costs to a minimum.

Start Cost Cutting Right at Your Desk

Why not do the simple and practical thing and give this modern fuse a trial throughout your plant. Even the first cost is no more than most old-fashion fuses. At the end of the year check up and see how operating efficiency has been increased, and fuse bills have been reduced. If you would like to know more about **BUSS SUPER-LAG** Fuses before ordering them from your distributor, complete information will be sent by mail or we will have a representative call, whichever you prefer.

BUSSMANN MANUFACTURING CO., St. Louis, Mo.
A Division of the McGraw Electric Company

THE BUSS SUPER-LAG FUSE

Easy Access promotes frequent cleaning

For Indoor or Outdoor Use

It is the frequency of cleaning that makes easy cleaning—and puts more light down in the working area

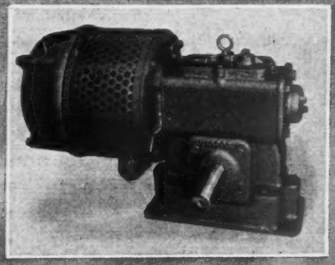
Thompson Hangers

—for high lamps, make reflector-cleaning easy and safe.

Get new 32-page Catalog; free upon request
Handled by leading electrical jobbers

THE THOMPSON ELECTRIC COMPANY
1438 West Ninth Street . . Cleveland, Ohio, U. S. A.

IDEAL UNIT TYPE MOTORS



COMPLETE or PART MOTORS

Motor-ized Speed Reducer

Because of their unique construction IDEAL Unit Type Motors are especially useful as built-in motors. Using the standard rotor and stator assemblies it is possible to build-in motors on machines where it has heretofore been impossible or undesirable. This can usually be done with very few changes in the present machines and at a small fraction of the cost of the conventional motor. Write us, now.

The IDEAL ELECTRIC & Manufacturing Co., Mansfield, Ohio

SALES REPRESENTATIVES IN ALL THE PRINCIPAL CITIES

Your name stamped on this book FREE

At no additional cost to you, we will stamp your name, or a friend's name, in gold on the front cover of any copy of **Palmer's Practical Mathematics** ordered from this advertisement. This is a special Christmas offer, limited to acceptance before January 1, 1932.

new second edition

of this comprehensive home-study treatment of mathematics for the practical man

Practical Mathematics for Home Study

by C. I. PALMER

Late Professor of Mathematics and Dean of Students, Armour Institute of Technology

606 pages, 5½x8, illustrated, flexible, $4.00

THIS book offers the practical man a complete training in practical mathematics such as he has occasion to use in his daily work. Every point is made clear. Every step is carefully explained. Principles are repeated over and over, applied again and again—until the ability to use them quickly and easily becomes a part of your regular working equipment.

The essential principles of arithmetic, geometry, algebra and trigonometry are included. More than 3,500 drill exercises are given, many problems and answers; based on the practical problems you face constantly. In this revision the exercises and examples have been thoroughly revised and many new problems have been added to cover up-to-date conditions in shop-work.

Covers:

ARITHMETIC. Gives a concise treatment of various subjects and their applications, checks of progress, degree of accuracy possible in solutions, and short cuts.

ALGEBRA. Gives sufficient drill to make direct applications to practical problems; equations are applied to practical problems; graphical methods are considered.

GEOMETRY. Covers both plane and spherical geometry. Definitions are stated clearly, devices and methods of practical men are used, together with applications to various trades.

TRIGONOMETRY. Gives many applications and emphasizes those parts that may be applied directly to practical problems.

Send your free stamping order now

Do you want to make a friend a gift combining personal thoughtfulness with real utility? Do you want a copy of **Palmer's Practical Mathematics** that you will doubly prize? Then take advantage of this free stamping offer. Send the coupon today. (Proper remittance should be enclosed with orders and, of course, stamped copies are not returnable.)

SPECIAL HOLIDAY OFFER COUPON

McGraw-Hill Book Company, Inc., 330 West 42d Street, New York.

Send me **Palmer's Practical Mathematics for Home Study, Second Edition** with name stamped in gold on the front cover. I enclose $4.00 and understand that stamped books are not returnable. (This offer expires Jan. 1, 1932.)

....
(Name to be stamped. Please print)

Name .....

Address .....

City and State ..... M.E. 12-31

VISIBILITY

"Hallowell"

Tool Stand of Steel

An instantaneous success because the "HALLOWELL" is bristling with novel advantages.

Everything inside is in full view so you can see at a glance what's there—yet it is under lock and key, thanks to the perforated enclosure.

And the locked top-cover swings back as shown and serves as a handy tray for the vise mounted on the side.

One padlock locks both top-cover and hinged door in front—so all in all could anything be more compact, complete and convenient?

Finally, the "HALLOWELL" can be trundled around from job to job, hence the casters and the handle bars. The plain legs serve to keep it steady when working at the vise.

Prices and Complete Data in Bulletin 433

WE MANUFACTURE:

"HALLOWELL" STEEL WORK-BENCHES
"HALLOWELL" STEEL WORK-TABLES
"HALLOWELL" STEEL WORK-BENCHES, SEMI-PORTABLE
"HALLOWELL" STEEL-WOOD WORK-TABLES
"HALLOWELL" STEEL-WOOD BENCH-DRAWERS
"HALLOWELL" STEEL BENCH-DRAWERS
"HALLOWELL" STEEL CHAIRS AND STOOLS
"HALLOWELL" STEEL LIFT-TRUCK PLATFORMS

STANDARD PRESSED STEEL CO.

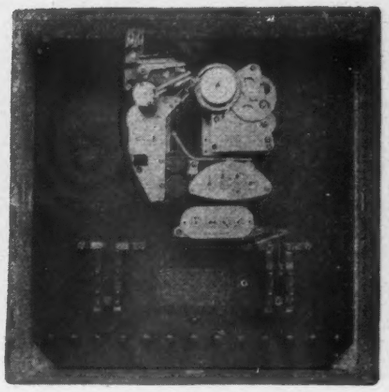
BRANCHES BOSTON CHICAGO DETROIT

JENKINTOWN, PENNA.
BOX 546

BRANCHES NEW YORK SAN FRANCISCO ST. LOUIS

The
POWER DEMAND LIMUTER

REDUCES *DEMANDS*



Eliminates the excessive and unnecessary peaks of the electric power demand automatically.

SIMPLE - RELIABLE

Write for Descriptive Bulletin

Manufactured by
STEEL CITY FURNACE COMPANY
P. O. Box 1008 Pittsburgh, Pa.

RIGHT LIGHT

means

better production
greater Safety
less spoilage
more contentment

"American" Adjustable Fixtures

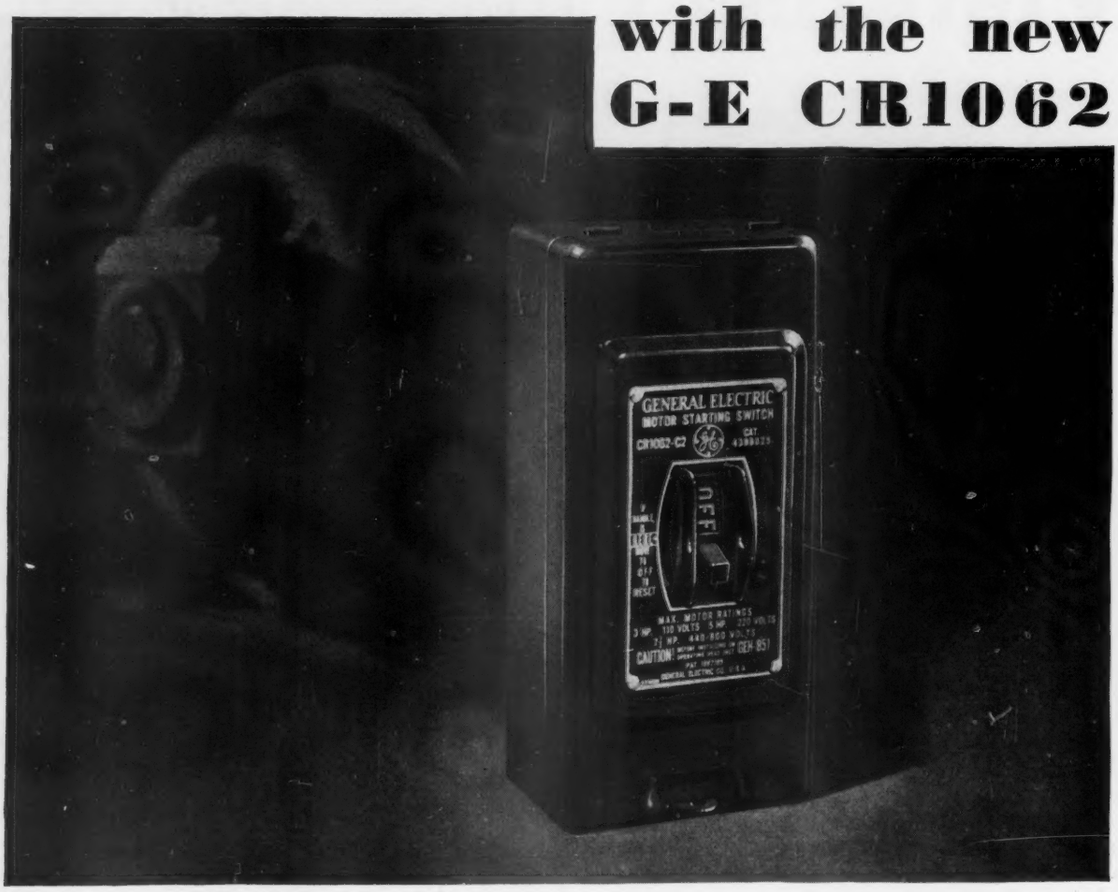
put the light right where it's needed.

Many well-known plants have adopted "American" as standard. They have found these fixtures not only most efficient in performance, but very economical in first cost.

Get our catalog No. 6. It shows fixtures to fit every requirement

American Fixture Company
764 N. Plankinton Ave. Milwaukee, Wis.

START RIGHT with the new G-E CR1062



The new G-E CR1062 manually operated motor-starting switch . . . good to look at both inside and out . . . mechanically and electrically correct . . . perfect partner in any combination that includes a small induction motor

AN a-c. motor-starting switch that's reliable ... simple ... easily wired ... yet inexpensive

In the new manually operated CR1062 motor-starting switch with hand-reset thermal overload device, General Electric offers you a switch that is not only moderately priced but easy and inexpensive to install. It is designed for full-voltage starting of small induction motors. It is good to look at. Built in a finely proportioned case with rounded corners, the CR1062 harmonizes with the lines of your most prized installation.

Not only does the simplicity of this new switch contribute to ease of inspection, it adds materially to its operating life. These and other features make the CR1062 of interest to you. Why not ask your nearest G-E sales office for a copy of publication GEA1522, which gives complete details?

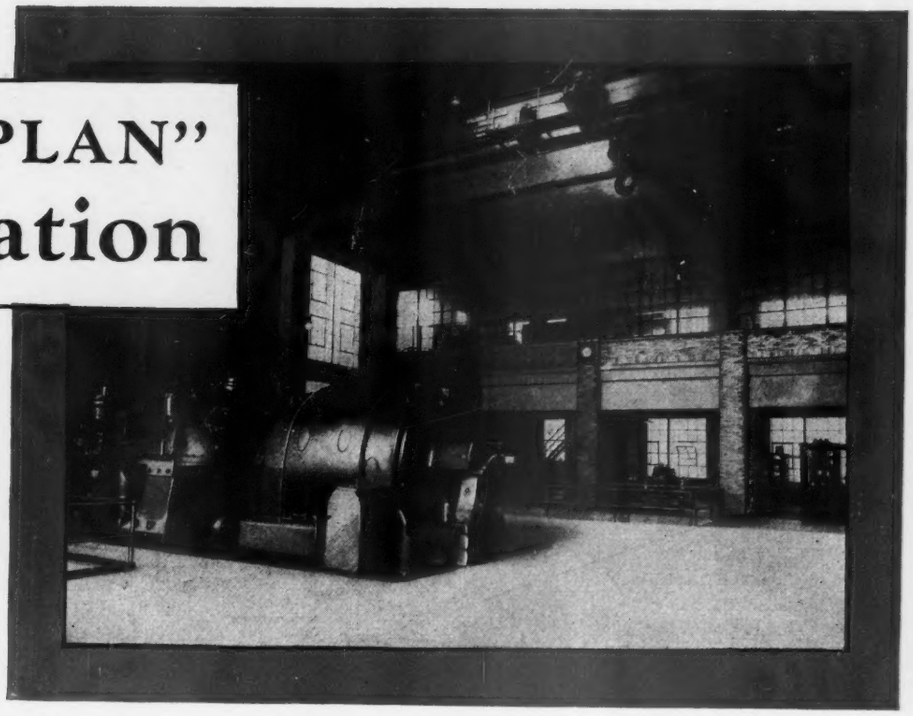
301-92

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

INVESTIGATE

"UNIT PLAN" Lubrication



...to increase your profits

Let our engineers discuss with you how you can speed production and cut operating costs with a complete lubrication plan specifying the proper oils refined from the proper crudes.

Earnings sheets at the end of the year can be improved by better lubrication. Plant managers who have adopted Cities Service "Unit Plan" of Lubrication have found this out. Let us talk to you about it... give you figures ...tell you just what Cities Service lubrication engineers can do to increase your plant's efficiency and cut your operating costs.

Cities Service affords widest choice of crude oils, including Pennsylvania, for any special lubricating job ... so, no matter what your problem is, let our engineers discuss it with you.

We'll provide plans for plants of every size and kind including all types of machinery from smallest lathe to giant turbine. Our engineers can be of saving service to you. Find out how—today. Just mail coupon below.

CITIES SERVICE OILS
ONCE - ALWAYS

CITIES SERVICE RADIO CONCERTS, Fridays, 8 P.M. Eastern Standard Time—WEAF and 37 Stations on N.B.C. Nation-Wide Network.

CITIES SERVICE COMPANY
60 Wall Street, New York, N.Y.
We are interested in your "Unit Plan" of Lubrication.

We operate.....machines.
number of
Our products are.....
.....
Name.....
Street.....
City.....*State*.....

CITIES SERVICE
INDUSTRIAL OILS

QUALITY PROVED WHERE IT SHOULD BE PROVED — IN INDUSTRIAL USE

As the Modern Locomotive excels the old "Wood-burner"

Preformed Wire Rope excels old-fashioned ordinary wire rope

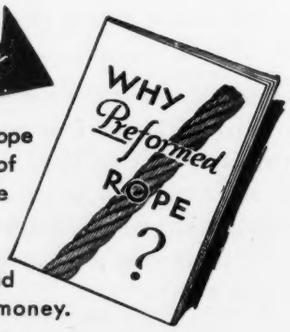
Wire rope is no longer merely "wire rope"

FOR many years one wire rope seemed to be about as good as another. New manners of combining wires were developed as the need arose. Stronger steels were developed. But the first *basic* improvement in nearly 100 years *is the elimination of internal stress in wire rope.*

● Internal stress in ordinary wire rope costs industry millions. Premature failure caused by fatigue . . . undue wear . . . uneven load distribution among the strands . . . these and many other destructive influences which shorten wire rope life are traced *directly* to *internal stress.*

● In Tru-Lay Preformed Wire Rope, internal stress is eliminated by preshaping the wires and strands to the exact shape they assume in the finished wire rope structure . . . so they lie in position without straightening-out tendency. 30% to 300% increased service results, as proved by hundreds of service reports in a wide variety of wire rope applications.

Send for this complete story



● Comparing Tru-Lay Preformed Wire Rope with old-fashioned ordinary wire rope is like comparing the efficiency of the modern locomotive with the old-time "wood-burner." Put wire rope on an up-to-date cost-per-dollar basis. You will find that Tru-Lay will save you money.

● Let us send you, or the man in your organization responsible for wire rope, a copy of "Why Preformed Wire Rope." Write for it on your business letterhead.

AMERICAN CABLE COMPANY, *Inc.*

New York Central Building, 230 Park Ave., NEW YORK CITY

District Offices: Atlanta, Chicago, Denver, Detroit, Philadelphia, Pittsburgh, Tulsa, San Francisco

The following manufacturers have been licensed to manufacture Preformed Wire Rope under the American Cable Company's Patents Nos. 1,513,583–1,518,253–1,643,150. (Other patents pending.)

(In the United States)
American Steel & Wire Co.
Broderick & Bascomb Rope Co.
E. H. Edwards Company
Hazard Wire Rope Co.
Pacific Wire Rope Co.

(In Canada)
Dominion Wire Rope Co., Ltd.
Anglo-Canadian Wire Rope Co., Ltd.
Canada Wire & Cable Co., Ltd.
B. Greening Wire Co., Ltd.

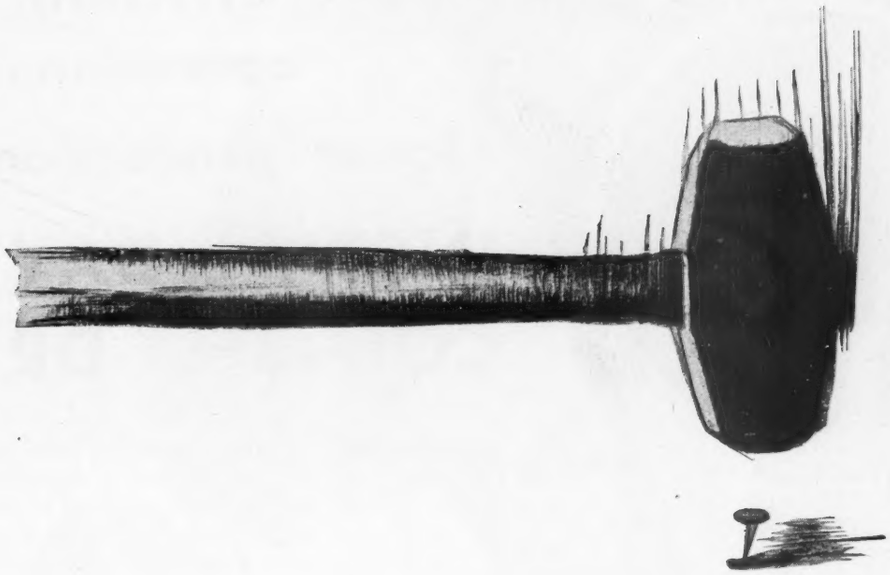
ACCO

An Associate Company of the American Chain Company, Inc.

TRU-LAY PREFORMED WIRE ROPE

30% to 300% Increased Service [Depending upon the character of the service and type of equipment

Why drive a tack with a sledge hammer?



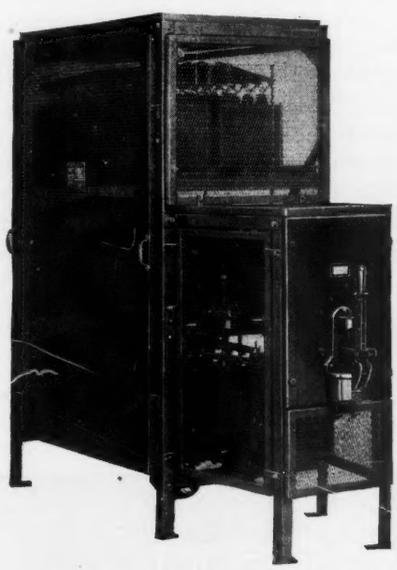
It can be done, but the equipment and the energy would be out of proportion to the requirements.

How often a similar condition is found in industry! How often electric distribution and generating equipment is out of proportion to the work done! This overinvestment is due to low power-factor.

Inefficiency of operation and high over-all cost of power are the inevitable results. You pay for electric service that returns nothing.

To combat this loss in a practical and economical manner, install General Electric capacitors. These power-factor "correctors" enable you to get a full day's work for your electrical expenditure—driving the tack efficiently.

A helpful bulletin (No. GEA-77) on the power-factor problem will be sent on request. Our engineers, located in principal cities, will assist you in making studies necessary for the most practical solution.



Typical capacitor for power-factor correction, 600 kv-a., 2300 volts. General Electric builds capacitors for every industrial need

850-19

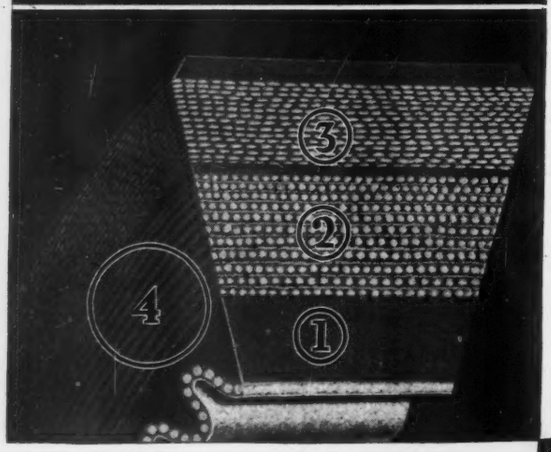
GENERAL ELECTRIC

CAPACITORS

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

1932 DEMANDS...

COMPLETE DRIVES—PULLEYS AND BELTS—IN STOCK—ALL RATIOS—FRACTIONAL TO 100 H.P.



1 The Cog section . . . "built to bend" for extreme flexibility at high speeds, without heating, distortion, buckling or rippling.

2 The "Neutral Axis" . . . the strength section. Permanently pre-stretched by Dayton's patented process.

3 The Outer Section . . . gives balance. Composed of layers of vulcanized, strong cord fabric, bias-cut to accommodate bending without strain or distortion.

4 The entire belt is die-cut for precision and greater gripping power. Daytons are accurate and *stay* accurate.

★ more efficient plant operation . . .

★ lower production costs

INSTALL DAYTON COG-BELT DRIVES

Today's lower price levels make necessary the elimination of waste in every form. Production costs must be lowered. In the important field of power transmission, production managers are turning to Dayton Cog-Belt Drives to effect revolutionary economies.

For Dayton Cog-Belt Drives save the constant replacement costs and servicing charges that ordinary drives entail. They're far more ruggedly built. They have longer life. And that's not all. They're far more efficient. The accurately die-cut belts do not slip in the pulley grooves. Therefore, exact speed ratios are maintained through greater gripping power. This means more uniform—and far cheaper—production.

Then, too, Dayton Cog-Belts are "Built to bend"—easily, without heating, at high speeds. Their pre-stretched construction and mechanical design eliminate the necessity for constant "take-ups." No lubrication or dressing is necessary.

But these are only a few of Dayton's outstanding advantages. Let us give you the whole story of Dayton features that provide more dependable, more productive and profitable operation for your machinery. Remember, there is a Dayton Cog-Belt Drive for every type of machine, from the lightest to the heaviest.

Send for a Dayton Cog-Belt Catalog and sample section of the belt . . . now.

THE DAYTON RUBBER MANUFACTURING CO.
DAYTON, OHIO

FACTORY DISTRIBUTORS IN PRINCIPAL CITIES AND ALL WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY SALES OFFICES

1-22

Dayton
COG-BELT DRIVES

Like new always

because it is packed in oil

REMOVE another roll of Empire Tape from the can, weeks, months, even years after the first rolls were used. Note how very flexible this insulation remains; how uniformly smooth the finish. It never grows old while submerged in oil.

Not only is this true of the physical properties, but also of the electrical characteristics. Dielectric strength is very high. Then, too, the dielectric power factor of Empire Oil Packed Tape is very low, a characteristic that makes it ideal for insulating joints of paper covered cables, and other insulated conductors.

Empire Oil Packed Tape is one of several forms of varnished insulations made by the Mica Insulator Company. Helpful information to assist you in deciding which form is most suitable for a given service is contained in our Catalog No. 87. A copy is yours for the asking, and so is our cooperation.

"An Electrical Insulation for Every Purpose"

Lamicoid laminated Bakelite sheets, tubes and rods. *Micanite* and *Super-Micanite* built-up mica in sheets, tape, tube and rod form. *Mica* varnished cloth and paper—varnished cambric tubing, etc. Write for Catalog 87 to 200 Varick St., New York or 542 So. Dearborn St., Chicago.

Sales Offices and Stocks at Cleveland, Pittsburgh, Cincinnati, San Francisco, Seattle, Birmingham, Los Angeles, U. S. A.; Montreal, Toronto, Canada. ***Factories at*** Schenectady, N. Y. and London, England.

MICO MICANITE

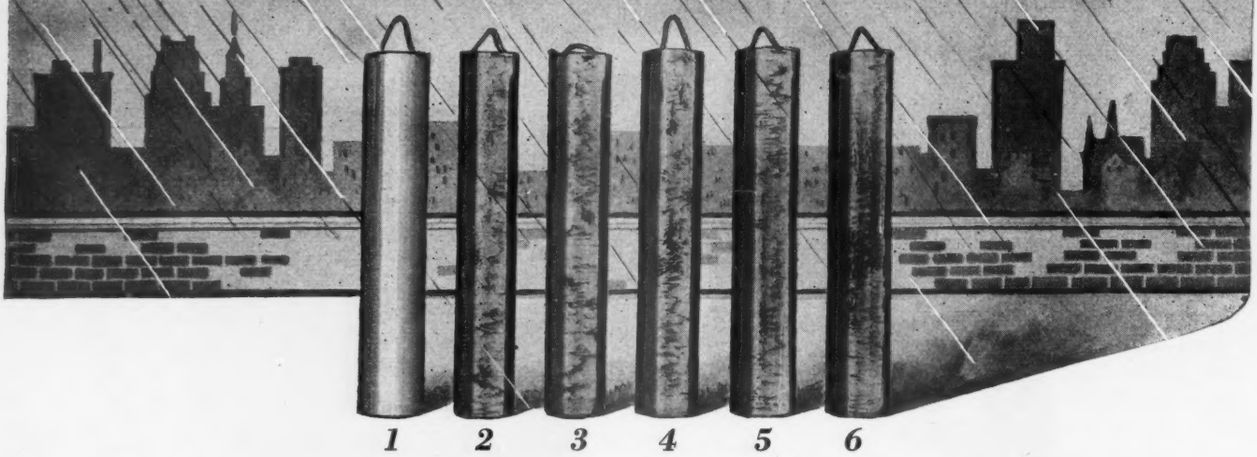
MICA INSULATOR COMPANY

Electrical Insulations

A Type For Every Purpose

LAMICOID EMPIRE

"Only bar No. 1 showed no trace of rust!"



Rain, sun and the other elements are powerful allies of rust—enemies of metal. A strong combination, but not unbeatable. Here's a case in point:

Not long ago, one of the great metal-working plants (you all know it) took six polished steel bars, covered each with a different make of rust preventive, and exposed them to the elements for a period of four months on the roof of one of their plant buildings. Here they were subject to the action of heat and cold, sun and rain, foundry fumes, and other adverse conditions.

We'll let the plant superintendent finish the story. He writes:

"Only bar No. 1 showed no trace of rust after this severe test. This bar was covered with your Rust Veto. In our opinion, the test conclusively proves the superiority of Houghton's Rust Veto over other makes of rust preventives."

There is a grade of Rust Veto for every purpose . . . every condition of climate and atmosphere. We invite a trial under any conditions you care to devise.

•

E. F. HOUGHTON & CO.

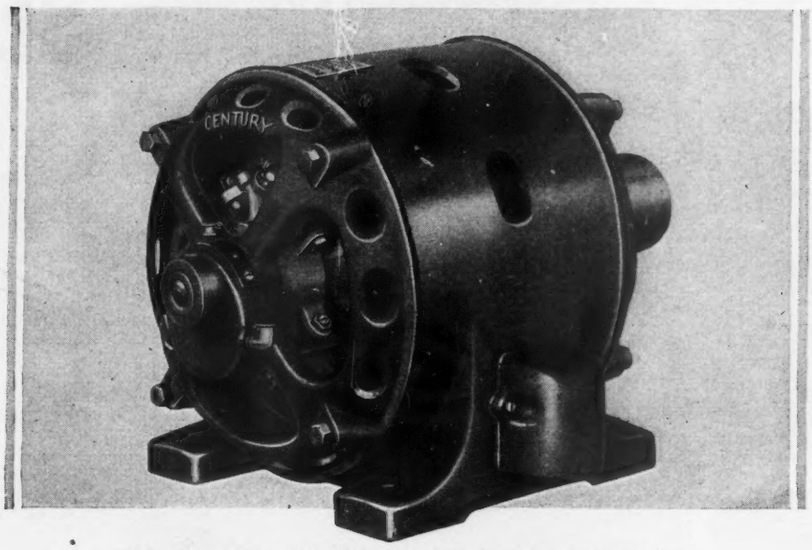
PHILADELPHIA :: CHICAGO :: DETROIT

And All Over the World

HOUGHTON'S

RUST VETO

THEY KEEP A-RUNNING



1 Horse Power Century Type RS Repulsion Start Induction Single Phase Motor

WINDINGS
Insulated and Sealed
RESIST MOISTURE

The thoroughly insulated windings of Century Type RS Motors are held securely in well-insulated slots by retaining wedges... The entire insulation cell is then saturated with insulating compound and protects the windings against the deteriorating effects of moisture... This means continued satisfaction both to the user and manufacturer of motor-driven apparatus—it is only one of many reasons why Century motors "Keep-a-Running" even when operating in moist or humid surroundings such as are frequently encountered on pumps, oil burners, refrigerating machines and similar exposed equipment and in tropical climates.

Built in sizes from 1/8 to 40 horse power.

Century MOTORS

40 U. S. and Canadian Stock Points and More Than 75 Outside Thereof

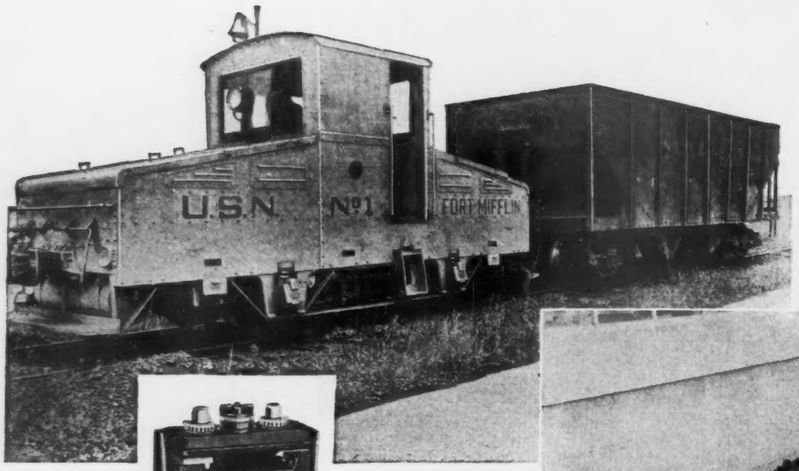
CENTURY ELECTRIC COMPANY, 1806 Pine St., St. Louis, Mo.

SINGLE PHASE, THREE PHASE AND DIRECT CURRENT MOTORS · MOTOR GENERATOR SETS · ROTARY CONVERTERS · FANS AND VENTILATORS

RI-91

FOR MORE THAN 27 YEARS AT ST. LOUIS

12 YEARS, 8 MONTHS' CONTINUOUS SERVICE



The 25-ton Storage Battery Locomotive that ran for 12 years and 8 months on the power furnished by the Exide-Ironclad Battery shown below.

●

The 220-cell Exide-Ironclad that gave 12 years, 8 months' dependable service in gruelling switching locomotive operation.

Cut-away cell showing construction like that of no other battery made. The reason for Exide-Ironclad dependability, long life and economy.

That's the performance of this 220-cell Exide-Ironclad Battery in this 25-ton switching locomotive

THINK OF IT! Over 12 years of switching tons of material, day in, day out. May sound impossible, but that's just what this Exide - Ironclad - equipped switching locomotive did for the U. S. Navy. This performance was the reason the original Ironclad Battery was replaced with another Exide-Ironclad.

And the reason for such performance is the different construction, dependability, reserve power and economy of the Exide-Ironclad Battery. Advantages of Exide-Ironclad-equipped storage battery locomotives are:

1—They do away with costly track electrification and trolley troubles.

2—Supply a switching service that withstands the most gruelling railroad conditions.

3—Clean, silent operation.

4—No sparks, smoke or fumes, thus permitting their use in buildings.

5—Reduced maintenance costs, because of fewer moving parts.

6—Power consumed only when in operation.

7—Large momentary overload capacity.

8—Operated safely and efficiently by one man.

9—Perfect, simple system of control.

10—Ready for instant use.

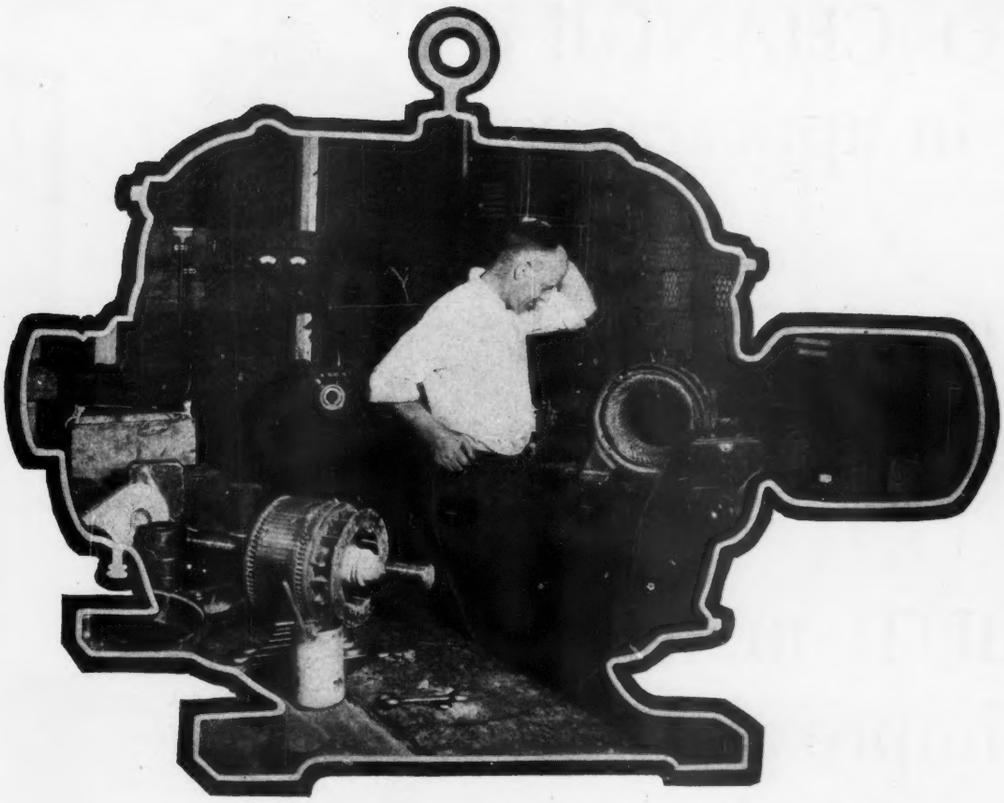
If you have a switching job in or around your plant, a storage battery locomotive equipped with an Exide-Ironclad Battery will serve to excellent advantage. Write for further facts, or have an Exide representative call and discuss your switching problems with you. No obligation of course.

Exide
IRONCLAD BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto



In Again!

DO you feel that way about old visitors to your electrical shop? And do you "fix 'em up" and send them out to the plant again, knowing darn well they'll be back in a short time?

Perhaps here's an idea that will help:

In brief: there are two big reasons for motor outage. They are bearing trouble and coil failures. These in turn are caused by certain familiar conditions. Analyze the conditions, then use bearings and windings that are not affected by those conditions—and you can eliminate a big part of motor failures.

Now we can't do much for you on bearings—we're wire manufacturers—but we can help you on windings and here's our story:

Some coil failures can never be avoided, of course. But many failures are the result of overheating which every electrical man knows is a regular thing. Then there are the motors operating in fume filled atmospheres and motors located where they get soaked with oil and grease and motors operating where the surrounding temperature is already high, many times over 100°F.

All these conditions under which motors operate have a definite deteriorating effect which finally results in failures, *many of which are absolutely unnecessary!*

And the moral of the story is this: you can make a winding with ROCKBESTOS Magnet Wire that will stand up against many severe conditions without failure. You can use ROCKBESTOS insulated motor lead cable and coil connection wire with these windings and you will then have a motor that is as free from electrical trouble as a motor can possibly be.

ROCKBESTOS Magnet Wire won't deteriorate even under constant temperatures up to 400°F. It can't burn. Fumes and even direct contact of many acids have no effect on it. Oil and grease can't rot it.

Make your job easier. Find out more about this remarkable wire and how it can help you. The information is free. Send the handy coupon for it—now!

ROCKBESTOS PRODUCTS CORPORATION
424 NICOLL STREET NEW HAVEN, CONN.

ROCKBESTOS—*the wire with permanent insulation*

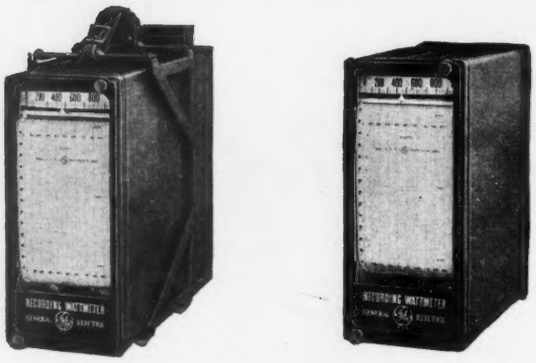
ROCKBESTOS PRODUCTS CORPORATION
424 Nicoll Street, New Haven, Conn.

Yes, let me have the whole story on ROCKBESTOS Magnet wire, motor lead cable and coil connection wire.

*Name*_____
*Title*_____
*Company*_____
*Address*_____

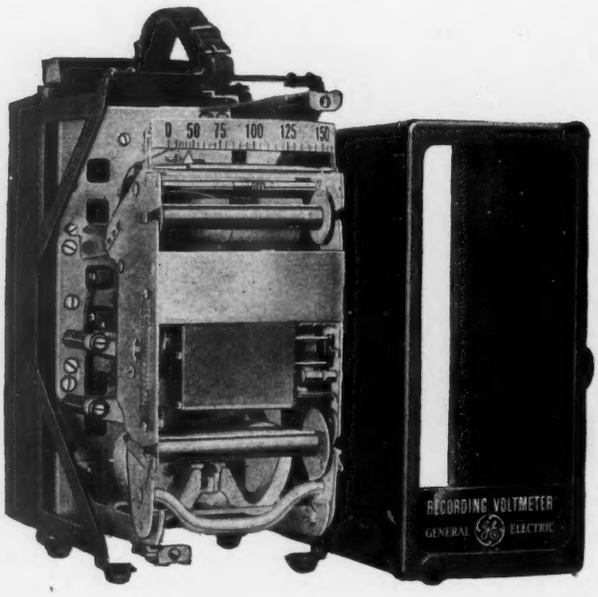
NO CHANGE in appearance

NO INCREASE in price



Portable and switchboard types; the latter front- and back-connected

BUT 10 major improvements beneath the cover



NOW, with a very reasonable investment, you can have adequate measuring equipment.

The improved features are:

(1) The terminal block on the portable model is tilted 30 degrees and allows the use of screw driver from the front. (2) Automatic brake for roll of supply paper balances pull of reroll; prevents pulling paper off driving sprockets, or overrunning the clock; permits accurate time keeping. (3) The clock* is completely enclosed; it affords nine days' operation per winding. (4) Reroll is positive — gear-driven — and easily removed. (5) Two turns of the thumbscrews are sufficient to fasten the cover. (6) Indicating scales are removable and interchangeable. (7) The chart reroll unit is separate and spring-driven, releasing the clock of all duty except keeping time. (8) The chart speed of portable types can be changed readily from inches per hour to inches per minute. This can be done without removing the cover. (9) Clock is started and stopped by setting a lever. (10) Automatic locking device prevents reroll spring from running down when the used-paper roll is removed.

Ask the nearest G-E sales office for Bulletin GEA-1061

***The preferred chart drive is the Telechron motor. It is recommended for superior chart timing on circuits of regulated frequency, and is supplied at the option of the purchaser.**

610-62

GENERAL ELECTRIC

RECORDING INSTRUMENTS

REPUBLIC CHAMPIONS

The Republic Champion Line . . . . when that is said, it is the final word. There can be no finer . . . better . . . longer lived . . . Mechanical Rubber Products than are incorporated in Republic's Champion Line. Whether it be Hi-Speed Transmission Belting, Oil Field Belting; Air, Creamery, Water or Rotary Hose; the pinnacle of manufacturing processes has been reached in the Champion Line.

THE REPUBLIC RUBBER CO.
YOUNGSTOWN, OHIO

OTHER REPUBLIC PRODUCTS

Transmission Belting
Conveyor Belting
Elevator Belting
Canning Belting
Acid Hose
Acetylene and Chemical Hose
Air Drill Hose
Creamery Hose
Contractor's Rubber Goods
Distillate Hose
Dredge Sleeves
Fire Hose
Garden Hose
Gasoline Hose
Pneumatic Tool Hose
Rotary Hose
Sand Blast Hose
Spray Hose
Suction Hose
Water Hose
Oil Well Supplies
Sponge Rubber
Molded Goods
Extruded Products
Mats and Matting
Packing
Valves

ROY W. HOWARD

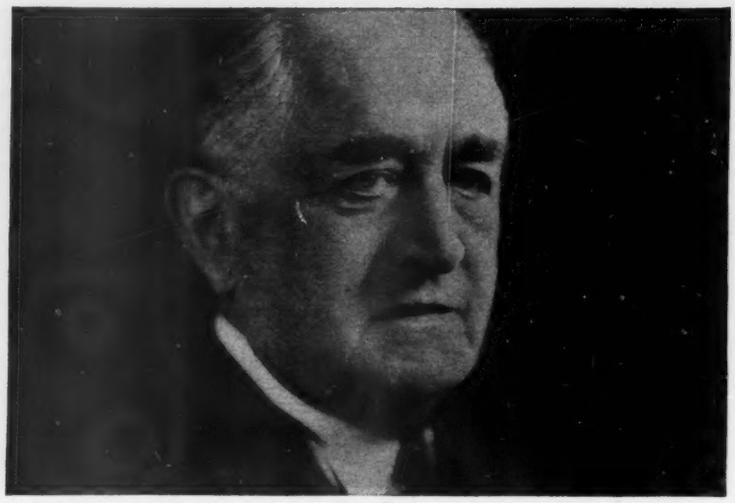
Chairman of the Board
Scripps-Howard Newspapers

● "The twenty-five Scripps-Howard newspapers are members of the Audit Bureau of Circulations because of their high regard for the Bureau's integrity and efficiency. The A. B. C. has provided the advertiser and his agent with the yardstick for intelligent buying of advertising space. The almost all inclusive membership in the Bureau is a tribute to the high standards of honesty prevailing in the publishing business."

ADOLPH S. OCHS

Publisher
The New York Times

● "The ABC of circulation is good—essential —as far as it goes; but there are twenty-three more letters in the alphabet of advertising, and knowledge of their application is also essential for the intelligent use of A. B. C. reports. 'All is not gold that glisteneth.' A printing press and a sheet of paper are not all that is necessary to make a newspaper, nor is the number of circulated copies the only information necessary to measure the value of newspaper space."



AS one of the leaders in American journalism puts it, "—nor is the number of circulated copies the only information necessary to measure the value of newspaper space."

An A. B. C. report is full of other information quite as important to the advertiser as the number of copies of the publication distributed. Men whose business it is to buy space should read every page of an A. B. C. report, for therein they will find answers to every question an advertiser wants answered. Only thus can they judge whether or not the publication will meet the requirements demanded.

Advertisers, publishers and agencies are working to give the advertiser —for whom the service is planned— this only complete, accurate knowledge about a publication's circulation. The maintenance of the organization which makes these facts available is vital to every advertiser. To help support it costs each an insignificant sum as compared with what it saves each advertiser yearly.

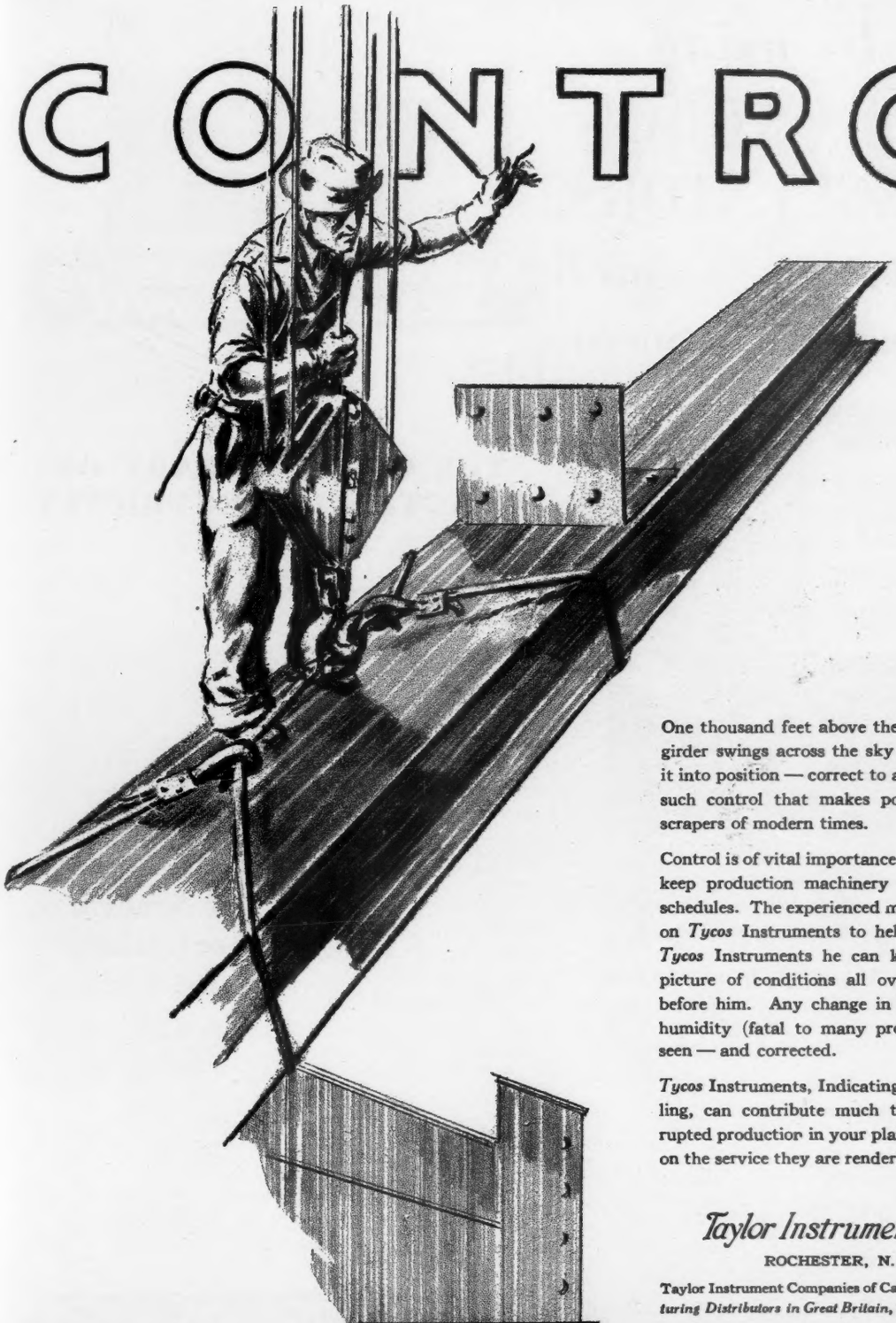
Those publishers who have given freely verified circulation information should be encouraged to continue this most valuable contribution to advertising.

The advertisers in the United States and Canada, having profited by this action on the part of publishers, should give their support to the A. B. C. by becoming members and taking an active interest in its work.

Complete information regarding membership may be had upon request.

An advertisement by the
AUDIT BUREAU OF CIRCULATIONS
Executive Offices • • • Chicago

CONTROL



One thousand feet above the sidewalk . . . a massive girder swings across the sky . . . skillful hands guide it into position — correct to a fraction of an inch. It is such control that makes possible the towering sky-scrapers of modern times.

Control is of vital importance to those whose job it is to keep production machinery on the move — to meet schedules. The experienced maintenance engineer relies on *Tycos* Instruments to help him in his job. With *Tycos* Instruments he can keep an accurate reliable picture of conditions all over the plant, constantly before him. Any change in temperature, pressure or humidity (fatal to many processes) can be instantly seen — and corrected.

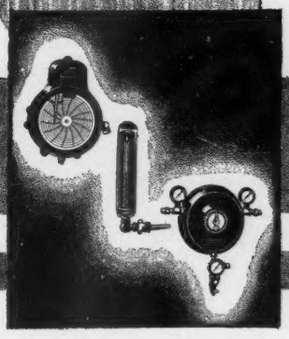
Tycos Instruments, Indicating, Recording and Controlling, can contribute much towards smooth, uninterrupted production in your plant. Write for information on the service they are rendering to industry.

Taylor Instrument Companies

ROCHESTER, N. Y., U. S. A.

Taylor Instrument Companies of Canada, Ltd., Toronto. *Manufacturing Distributors in Great Britain*, Short & Mason, Ltd., London.

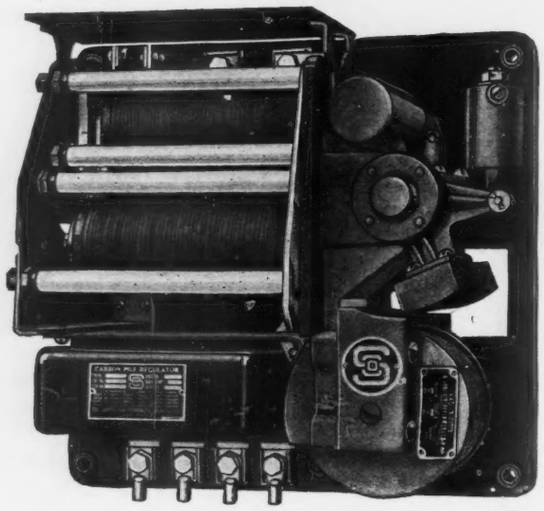
Tycos TEMPERATURE INSTRUMENTS —



INDICATING RECORDING CONTROLLING

Save by using SAFETY CARBON PILE REGULATORS

To Automatically Control Voltage, Current and Speed



The installation of Safety Carbon Pile Regulators is an important consideration in turning out better products with lower costs. Specific applications embrace a long list of industries of varied complexion which have benefited by their installation.

Accurate and economical, there is a Safety Carbon Pile Regulator for every requirement.

A.C. and D.C. application.

Write for Bulletin 3112B.

***The* SAFETY CAR HEATING & LIGHTING CO.**

NEW YORK : CHICAGO : ST. LOUIS : BOSTON
PHILADELPHIA : SAN FRANCISCO : MONTREAL

Know Electricity as Experts Know It!

HERE in seven easy-to-handle, easy-to-understand volumes is a complete electrical training—one that will enable you to know electricity as experts know it and qualify you for an expert's pay.

THE CROFT LIBRARY OF PRACTICAL ELECTRICITY

A combined reference library and home-study course in practical electricity.

THE Croft Library contains nearly three thousand pages, with two thousand of the clearest illustrations ever put into book form. Each of the volumes is indexed so that everything you want to know about electricity is at the fingers' ends.

In these volumes Croft teaches you electrical practice complete. He takes you in quick, easy steps from the simplest principles to the complete and economical operation of a great central station. He tells you all that he has learned in twenty years of shirt-sleeve practice.

With these books at his elbow a man can learn as much about electricity in six months—good practical "bread and butter" stuff—as he would ordinarily learn in a lifetime of practice.

Take advantage of this big free offer!

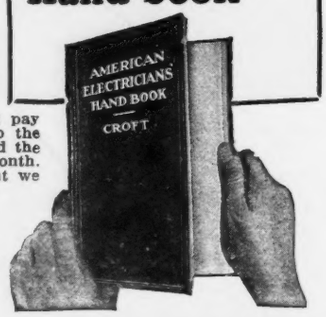
For a limited time we are offering a copy of Croft's American Electricians' Handbook with the Croft Library, at no addional charge. It's a premium for promptness—for ordering now instead of later.

Free examination — no money down—only $1.50 in ten days and $2.00 a month until paid.

Fill in and mail the coupon attached and we will send you the entire set of seven volumes for ten days' Free Examination. We take all the risk—pay all charges. You assume no obligation — you pay nothing unless you decide to keep the books. Then $1.50 in ten days and the balance at the rate of $2.00 a month. Upon receipt of your first payment we will send you a free copy of Croft's American Electricians' Handbook. Send the coupon NOW and see the books for yourself.

This offer is good only to December 31st. Get your copy of the American Electricians' Handbook by ordering NOW!

FREE—
if you act now!
The American Electricians' Hand book



FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 330 West 42d Street, New York, N. Y.

Gentlemen:—Send me the Croft Library of Practical Electricity (shipping charges prepaid) for 10 days' free examination. If satisfactory, I will send $1.50 in ten days and $2 per month until the special price of $19.50 has been paid. If not wanted I will write you for return shipping instructions. Upon receipt of my first payment of $1.50 you are to send me a copy of Croft's **American Electricians' Handbook**, absolutely free. (Write plainly and fill in all lines.)

Name.....

Home Address.....

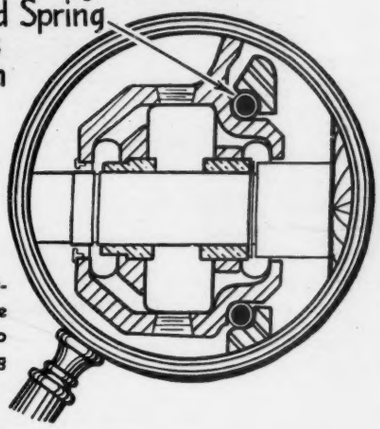
City and State.....

Employed by.....

Occupation.....M.E. 12-31

NO. 5 OF A SERIES OF 6 ADS

Concentrically held Rubber Cushioned Spring absorbs vibration



Leland cradle-mounted motors are surprisingly quiet which characteristic is in a large measure due to the following eatures:

Quietness

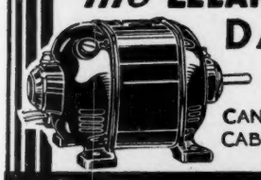
OF OPERATION

1. **Brush Lifting:** Brushes lift in a fractional part of a second, eliminating brush noise and wear.
2. **Vibrationless:** Cradle base theoretically and practically designed so as completely to isolate vibration within the frame structure.
3. **Inherently quiet:** The slot ratio chosen for constant permeance regardless of rotation—hence quiet magnetically.
4. **Self-filtering lubrication:** Generous bearing design with a constant film of oil between the bearing and journal, with cushioning effect of armature floated on oil.
5. **Uniform air gaps:** Accuracy of machining insures concentric and uniform air gaps—very necessary in quiet operation.
6. **Many other small features designed specifically for quiet operation.**

A. C. Repulsion Induction
A. C. Polyphase
D. C. Compound Wound
Interchangeable Frames

Write for Bulletin No. 28

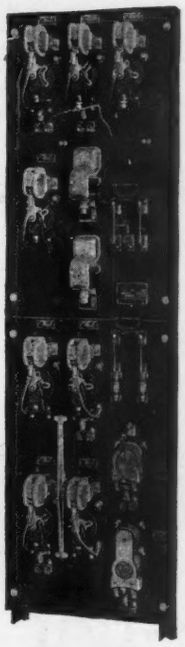
The **LELAND ELECTRIC CO.**
DAYTON · OHIO
U · S · A



CANADIAN ADDRESS · TORONTO
CABLE ADDRESS · LELECT-DAYTON

Leland Motors

CLARK "3C" MAGNETIC CONTROL



The illustration shows a Clark "3C" Standard Reversing, Plugging Type, complete, floor mounted Magnetic Control Panel for direct current steel mill service.

The same standard mounting would be used for plain reversing without plugging; also for non-reversing panels.

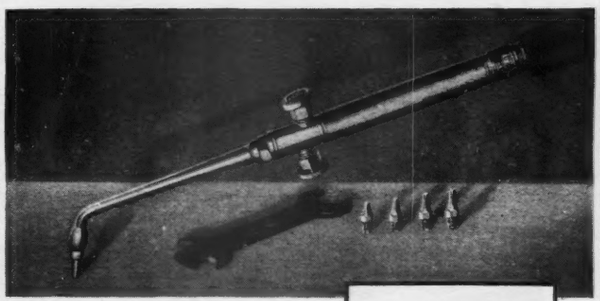
This method of mounting lends itself very nicely to the practice of lining up any number of controllers close together to present the appearance of one large switchboard of uniform height with uniform clearance between the floor and the lower edge of all panels.

On these Clark "3C" Controllers *Every Accelerating Contactor is its own Relay.* This is a feature of importance to the Operating Department. It means less electrical contacts for the same required performance. Therefore less time necessary for inspection. It means less chance for something to go wrong electrically, hence fewer possibilities of delay.

In brief, if you specify D. C. Magnetic Controllers wherein *Every Accelerating Contactor is its own Relay*, you will save money in the long run.

THE CLARK CONTROLLER CO.
AKRON, O. CANTON, O. 1146 EAST 152ND ST. NEWARK, N.J. PITTSBURGH
BIRMINGHAM CHICAGO **CLEVELAND, O.** NEW ORLEANS ST. LOUIS
BOSTON CINCINNATI DETROIT MIAMI, FLA. NEW YORK SAN FRANCISCO
BUFFALO DALLAS, TEX. LOS ANGELES MINNEAPOLIS PHILADELPHIA SEATTLE
AGENCY IN CANADA—RAILWAY & POWER ENGINEERING CORPORATION, LIMITED
•OWNING AND OPERATING SUNDH ELECTRIC CO., NEWARK, NEW JERSEY•

PUROX *style* 00 WELDING TORCH

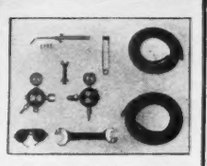


for delicate HEATING JOBS

THE Purox Style 00 Welding Torch will do any light welding, soldering, brazing, or lead-burning job you give it. Its light weight and fine balance make it extremely useful in battery, radiator, dental and jewelry work. It can be used for hours without fatigue and is easily handled in small working space.

A wide variety of gas combinations can be used with this torch: oxy-acetylene, oxy-hydrogen, oxygen and city gas, or compressed air and hydrogen. A mixer and five one-piece, hard-drawn, copper tips are furnished for the combination you prefer.

Moderate price and low operating cost make the Purox Style 00 Welding Torch a desirable addition to your shop equipment. It is sold separately or as part of the Purox No. 4000 Welding Outfit. Your jobber will be glad to show you either. Or, if you prefer, write us direct for further information.



The Purox No. 4000 Welding Outfit consists of:

1—Style 00 Torch with Tips Nos. 1, 2, 3, 4 and 5, and Wrench
1—Style 12 Oxygen Regulator with 30-lb. Gauge
1—Style 23 Acetylene Regulator with 30-lb. Gauge
1—Regulator Wrench
10 ft. 16-in. Green Oxygen Tubing
10 ft. 16-in. Red Acetylene Tubing
1—Spark Lighter
1—Pair Spectacles

Price $42.13
(Shipping Weight, 10 lbs.)

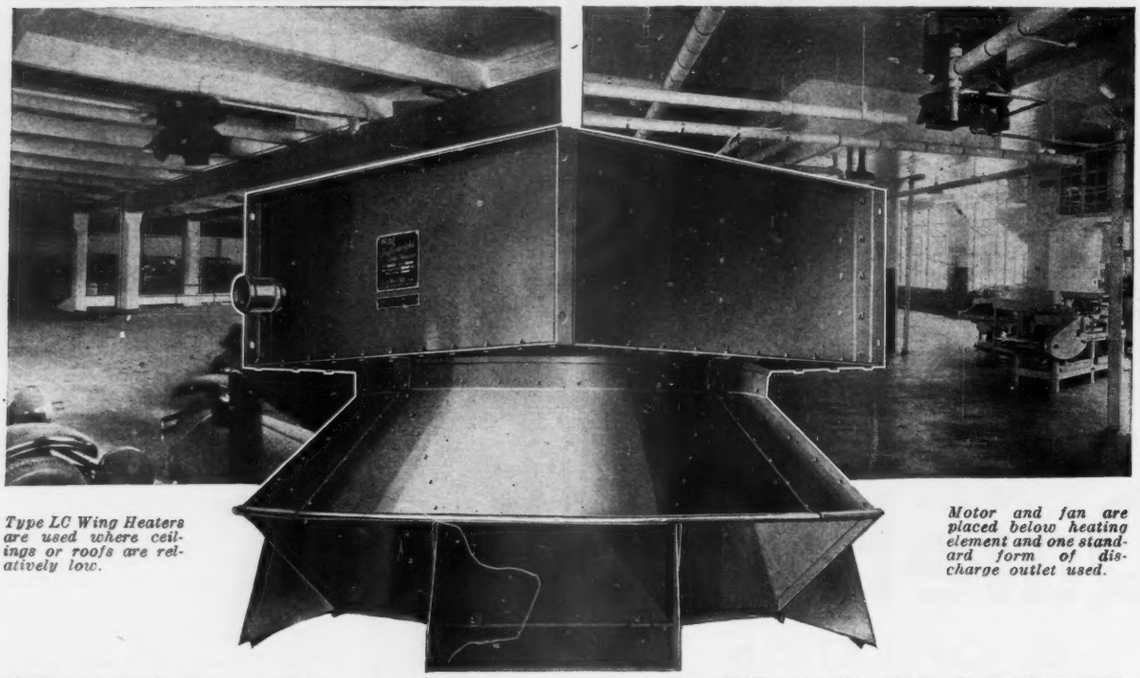
Purox Style 00 Welding, Brazing and Lead-Burning Torch with 5 Tips and Wrench

Price $14.50

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
New UCC York

PUROX
WELDING AND CUTTING APPARATUS AND SUPPLIES

THERE IS A DIFFERENCE IN UNIT HEATERS



Type LC Wing Heaters are used where ceilings or roofs are relatively low.

Motor and fan are placed below heating element and one standard form of discharge outlet used.

WING Design is EXCLUSIVE with WING Featherweight Unit Heaters

Wing Featherweight Unit Heaters were the first light weight unit heaters on the market. Wing design is, therefore, the result of years of experience devoted to solving unit heating problems. The present design of Wing Featherweight Unit Heaters is original and exclusive with Wing Heaters.

The main features are (1) light weight; (2) the vertical downward discharge of the heated air, and (3) multiple discharge outlets.

It is these features that are directly responsible for the great economies possible in industrial plant heating by the use of Wing Featherweight Unit Heaters.

These economies and advantages may be summarized briefly as follows:

Economy of Steam — Heated air is projected from the highest point in the room or building, preventing accumulation of heated air at this point. Heat may be controlled, manually or thermostatically. Buildings are heated more rapidly, as warmth is felt at floor level as soon as the Wing heaters are started.

Space Conservation — Heaters are removed from working floor and placed overhead.

Comfort — No deadening radiant heat. No cold drafts.

Low Cost of Equipment — Multiple discharge outlets assuring complete and uniform distribution of heat, fewer heaters are required.

Low Installation Cost — Simplicity of piping and fewer units, requiring fewer valves, traps, etc., make for economical installation.

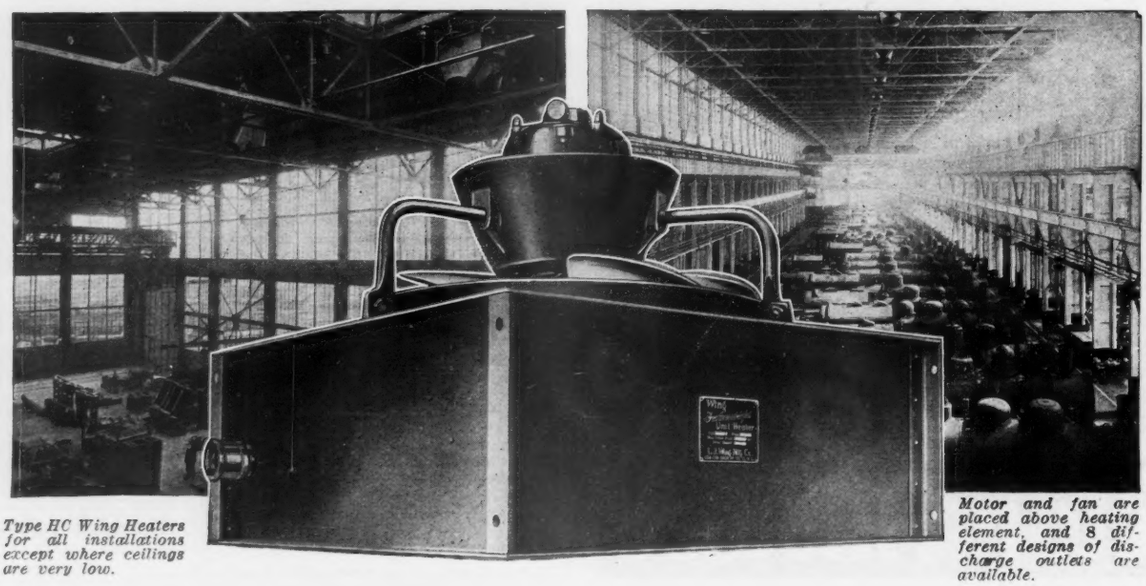
Low Maintenance Cost — Require cleaning and lubricant but once a year. No other maintenance cost.

Write for a copy of our complete catalog, containing a complete discussion of unit heater design and costs. If you have a copy of SWEET'S Engineering Catalogs (1931) you may consult it in that reference book.

L. J. WING MFG. CO., 162 W. 14th St., NEW YORK CITY

Specialists in the design and manufacture of air-handling equipment since 1878

Unit Heaters - Fog Eliminators - Exhausters - Turbine Blowers - Motor Driven Blowers - Safety Ventilating Fans - Man Coolers



Type HC Wing Heaters for all installations except where ceilings are very low.

Motor and fan are placed above heating element, and 8 different designs of discharge outlets are available.

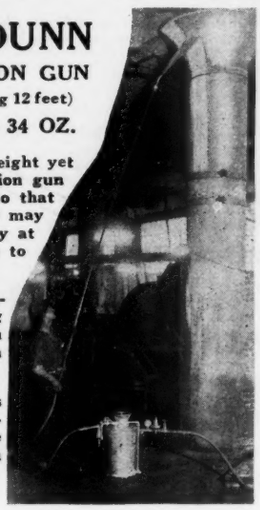
MAINTENANCE Service Section

for PLANT, MILL AND FACTORY EQUIPMENT, MATERIALS AND SUPPLIES

THIS **DUNN** EXTENSION GUN

(measuring 12 feet)

WEIGHS 34 OZ.



A feather weight yet rigid extension gun adjustable so that the operator may always spray at right angles to the surface.

Makes ceiling painting cleaner than by brush method.

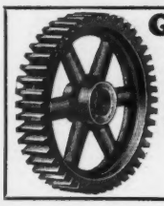
"Ten years ahead, because we specialize in maintenance painting."

A Product of

The Burrshel Company INCORPORATED

90 West St., New York

Dunn Patent Painting Machines.
Burrshel Portable Air Compressors.
Vapor Spray Cleaning Machines



Gears In Stock — Immediate Delivery

Gears, speed reducers, sprockets, thrust bearings, flexible couplings, pulleys, etc. A complete line is carried in our Chicago stock. Can also quote on special gears of any kind. Send us your blue prints and inquiries.

Write for Catalog No. 35.

CHICAGO GEAR WORKS
769-763 W. Jackson Blvd.,
CHICAGO, ILL.

THIS new advertising section affords opportunity to broaden the service of ***Maintenance Engineering*** *in acquainting readers with additional products and services of value in plant maintenance work.*

Advertisements of less than one-quarter page size are grouped under this heading for the convenience of readers in giving these announcements careful attention each issue.

Hydro-Proof

for Repairing or Resurfacing Industrial Floors

The Asphalt Products Co., Inc.
Syracuse, N. Y.

UNICRETE
(REG. U.S. PAT. OFF.)
IS A FLOOR THAT CONSTANTLY IMPROVES WITH USE
WE WILL MAIL YOU A FOLDER
The Union Products Company
Cleveland, Ohio
EST. 1900

NEW

Model GH Paint-O-Mister

Painting is one of the plant problems that calls for more men than present budgets permit . . . that is, painting by costly brushed-on methods.

To meet these conditions, we have developed a new and larger spraying outfit which is designed for painting larger surfaces . . . it can be used for all painting jobs . . . yet it is a real ONE MAN outfit. With this new unit ONE MAN can do the painting that would require from three to five men using brushes.

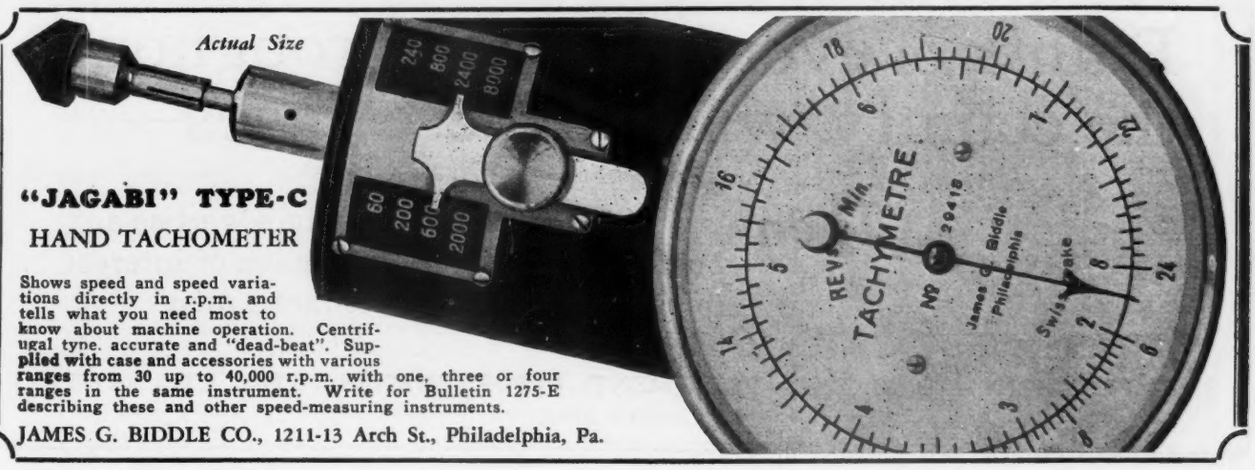
Solve your problem of how to get five men's work from the one man left on the painting staff.

This is a portable unit and less cumbersome than truck mounted outfits, and is priced in accordance with today's cost.

We would consider it an interest in the subject and not an obligation on your part, if you should ask us to send you a copy of the detailed description of this new unit.

ATCO PRODUCTS CORP., 5 Scott Avenue, Rahway, New Jersey

Actual Size



"JAGABI" TYPE-C

HAND TACHOMETER

Shows speed and speed variations directly in r.p.m. and tells what you need most to know about machine operation. Centrifugal type, accurate and "dead-beat". Supplied with case and accessories with various ranges from 30 up to 40,000 r.p.m. with one, three or four ranges in the same instrument. Write for Bulletin 1275-E describing these and other speed-measuring instruments.

JAMES G. BIDDLE CO., 1211-13 Arch St., Philadelphia, Pa.

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or SPECIAL

UNDISPLAYED—RATE PER WORD:

Positions Wanted, 5 cents a word, minimum $1.00 an insertion, payable in advance.

Positions Vacant and all other classifications, excepting Equipment, 10 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH

1 inch $6.00
2 to 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch

Other spaces and contract rates on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

M.E.

EMPLOYMENT SERVICE

IF YOU are qualified for position between $2,500 and $25,000, and are receptive to negotiations for new connections, your response to this announcement is invited. The undersigned provides a thoroughly organized service, established twenty-two years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not a registration bureau. Retaining fee protected by refund provision, as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 258 Main Street, Buffalo, New York.

POSITIONS WANTED

ELECTRICIAN, A-1. All-around mechanic, 17 years experience, installation, maintenance, alternating and direct current equipment; expert armature winder and trouble shooter, elevators, printing press, remote controllers; make bearings, etc. Accept moderate wages anywhere. PW-385, Maintenance Engineering, 520 No. Michigan Ave., Chicago, Ill.

EXPERIENCED Industrial Engineer. Technical education. Eight years sales experience. Fourteen years factory experience as chief mechanical engineer. PW-386, Maintenance Engineering, 330 W. 42nd St., New York.

MECHANICAL engineer, 36, experienced in mill and factory maintenance and construction, desires position of plant engineer or manager. PW-384, Maintenance Engineering, 520 No. Michigan Ave., Chicago, Ill.

SALESMAN WANTED

Salesmen Wanted in Various Sections of the country to sell established complete line of Paint Brushes. Liberal commissions. David Linzer & Sons, 10-20 Astor Place, New York City."

ELECTRICIANS
INSTRUCTED FOR
MASSACHUSETTS LICENSES
BY CORRESPONDENCE
And Phonograph Records
SEND FOR PROSPECTUS
KENSLEA SCHOOL No. 23 CAMBRIA ST.
BOSTON, MASSACHUSETTS

FOR SALE
GENERATING UNIT
1—Kohler Model 5A51 Automatic Gasoline-Electric Generating Unit: Generator 5 kva., 220 volt, 60 cycles, 1200 r.p.m., new.
ALBERT A. EVERETTS
Lewisburg, Pa.

1400 Motors
ALL Sizes up to 100 H.P. in stock. Get our prices on guaranteed rebuilt motors.
MOTOR SERVICE COMPANY
Phone Douglas 1600
3300 Indiana Avenue, Chicago, Illinois

New "SEARCHLIGHT" Advertisements
must be received by the 21st of the month to appear in issue of the 1st of the following month.
Address copy to the Searchlight Department
Maintenance Engineering
330 West 42nd St., New York City

OVER 14,000 other men in responsible charge of Operation & Maintenance work in Industrial Plants of every variety throughout the country, will see these pages—

Then isn't this the logical place to advertise any business wants you may have of interest to operation and maintenance men?

EMPLOYMENT — BUSINESS — EQUIPMENT OPPORTUNITIES, ETC., ETC., ETC.

J. L. HEMPHILL & CO. Inc.

ELECTRICAL ENGINEERS AND EQUIPMENT

803 Williams St. North Bergen, N. J.

Telephones: Palisade 2600-2601

MOTOR GENERATOR SETS

1—500 kw., 250 v., Westinghouse Synchronous motor Generator Set.
1—300 kw., 125 v., 3 wire, 3 unit, Ridgeway.
1—500 kw., 250 v., Westinghouse Synchronous motor Generator Set.
1—250 kw., 230 v., 3 ph., 60 cy., 2300-2600 v. Synchronous Motor Generator Set.
1—200 kw., 230 v., 3 ph., 60 cy., 2300-4100 v. Synchronous Motor Generator Set.
1—150 kw., 600 r.p.m., 250 v., Gen., 3-ph., 60 cy., 220-440 v., G. E. Synchronous motor.
1—125 kw., 250 v., Westinghouse Synchronous Gen. Motor Set, 3 ph., 60 cy., 230-2200 v.
1—100 kw., 125 v., D.C., 220-440 A.C. G. E. Synchronous Motor Generator Set, 220-440 v.
1—100 kw., 250 v., Gen., 900 r.p.m., 2200 Synchronous Motor.

TURBINES

1—75 kva., 3 ph., 60 cy., Westinghouse Geared Non-Condensing Turbine.

TRANSFORMERS

1—1500/3000 kva., G. E., combined oil and water cooled 3 ph., 60 cy., 11000-22000-2300 v.
3—50 kva., G.E., 13000/26000—220/40.

A.C. GENERATORS

No.	Kw.	R.p.m.	Volts	Ph.	Type
1	400	900	2300–4000	3	Westg.
1	350	600	440	3	Westg.
2	125	900	2300	3	Cr.-Wh.
2	100	900	230–2300	3	G.E.
1	75	600	220	3	Westg.
1	75	900	2300	3	G.E.
1	50	1200	220–440–2300	3	G.E.

MOTORS—3 Phase, 60 Cycle

No.	Hp.	R.p.m.	Volts	Type
1	500	900	440/4000	Westinghouse Syn.
1	500	900	440–2200	G.E. Syn.
1	350	900	2200/4000	Wh. syn.
2	300	600	445–2300	G.E. Syn.
1	250	600	2200/4000	G.E. syn.
1	250	600	220–400	Westg. syn.
1	250	600	440–2200	G.E. syn.
3	200	514	4150–2300	G.E. syn.
2	175	3 ph.	60-cy	2300 volts. G.E.
4	150	1200	220/440	Westg. sl. ring.
1	150	900	2200	G.E. syn.
2	150	514	2200	Westg. sl. ring.
1	150	1800	2200	West. sq. cg. mfr.
1	100	900	440/2200	G.E. sq.cg.
1	100	900	220–440–220	Westg. sq.cg.

D.C. GENERATORS

No.	Kw.	R.p.m.	Volts	Type
1	200	900	250	G.E.
1	200	600	250	G.E.
1	200	525	250	G.E.
2	150	1200	250	Cr.-Wheeler
1	150	600	250	G.E.
2	150	1200	250	Westg. new
1	100	720	250	G.E.
1	75	450	250	Diehl.

(Smaller Sizes on Request)

D.C. MOTORS—230 VOLT

No.	Hp.	R.p.m.	Type
1	250	550	G.E.
2	200	1150	Cr.-Wheeler
1	150	600	G.E.
3	150	850	Westg. SK., new
1	150	1100	Westg. SK.
1	125	550	Cr.-Wheeler
1	100	625	Westg. Type S.

(Smaller Sizes on Request)

D.C. MOTORS—125 VOLT

No.	Hp.	R.p.m.	Type
1	125	575	G.E.
1	100	600	G.E.
1	80	600	G.E.

SLIP-RING MOTORS—3 Ph., 60 Cy.

Hp.	Volts	Make	Speed
220	220-440	G.E.	450
200	2300-4000	G.E.	514
200	2200-440-220	G.E.	600
150	2200-440-220	G.E.	514
150	220-440-550	G.E.	600
100	2200	Westghse.	900
100	2200	G.E.	720
100	550	G.E.	720
100	440-220	G.E.	720
100	440-220	G.E.	900
75	550	Westghse.	720
75	440-220	G.E.	600
60	440-220	G.E.	720

DIRECT CURRENT MOTORS

Hp.	Volts	Speed	Make	Type
100	230	1150	G.E.	LC
100	230	625	Westghse.	SK
50	230	1050	G.E.	RC
50	115	565	G.E.	DLC
40	230	750	G.E.	RC

DIRECT CURRENT GENERATORS

Hp.	Volts	Speed	Make	Type
100	250	725	Westghse.	SK
50	125	725	G.E.	DLC
40	250	850	G.E.	RC
35	250	1050	Westghse.	SK

MOTOR GENERATOR SETS

1—500-kw., 250-275-V., 720-r.p.m., G.E. connected to ATI 2300-4100-V., synchronous motor
1—150-kw., 250-275-V., 1200-r.p.m., G.E. connected to 225-kva., 2300-4000-V., 3-ph., 60-cy., synchronous motor.
1—145-kw., 125-V., 900-r.p.m., Westghse. connected to 285-hp., 2400-4100-V., 3-ph., 60-cy., synchronous motor.
1—85-kw., 125-V., 1200-r.p.m. Westghse. SK. connected to KT 440-220-V., 60-cy., S.C. motor.
1—65-kw., 125-V., 1200-r.p.m., G.E., R.C., connected to KT., 2200-440-220-V., 60-cy., squirrel-cage motor.

A.C. GENERATORS

1—225-kva.,600-r.p.m.,240-480-V., G.E.
1—187-kva., 720-r.p.m., 2200-440-220-V., G.E.
1—150-kw., 900-r.p.m., 2200-480-240-V., G.E.
1—120-kva., 900-r.p.m.,2300-4000-V., G.E.
1—112 ½-kva., 900-r.p.m., 2200-240-480-V., G.E.
1—75-kva., 1200-r.p.m., 2200-480-240-V., G.E.
1—56-kva., 1200-r.p.m., 240-480-V., G.E.
1—50-kva., 1200-r.p.m., 2300-480-240-V., G.E.

ENGINE GENERATOR SET

1—Ames Uniflow—G.E., 312-kva., 200-r.p.m., 2300-240-480-V., 3-ph., 60-cy.

Stephen Hall & Co., Inc.

693 Adams St., Hoboken, N. J.

SYNCHRONOUS MOTOR

100-hp., 900 r.p.m., 3 ph., 60 cy., 220 v., .8 PF General Electric, type TS, with direct connected exciter.—PRACTICALLY NEW.

AIR COMPRESSORS

7x6 Ingersoll-Rand, class ER-1.
9x8 Ingersoll-Rand, class ER-1.
10x10 Ingersoll-Rand, class ER-1.

ENGINE-GENERATOR

300 kva., .8 PF, 3-60-2300 v. General Electric Generator, direct connected to 18x30 Hamilton Corliss 4-valve engine.

A.C. GENERATOR

350 kva., 3 ph., 60 cy., 2300 v., 514 r.p.m. Westinghouse three bearing type generator.

Just a few of many items selected at random from our large and varied stock of ONE YEAR GUARANTEED power equipment. Send for 72 page illustrated stock list—Bulletin No. 39.

Rockford Power Machinery Co.

625 7th St., Rockford, Ill.

GREGORY HI-GRADE-REBUILT

Motors Generators, Transformers, Meters, Exhaust Fans, Blowers, Pumps, etc. All standard makes and sizes at Rock Bottom Prices. Money-back guarantee.

Send for 80-page Bargain Sheet

GREGORY ELECTRIC CO.

W. 16th at Lincoln Street,
CHICAGO

ELECTRICAL MACHINERY

Motors and Generators. A.C. and D.C. for sale at Attractive Prices. Large Stock. New and Rebuilt. All Guaranteed. *Write for Stock List and Prices.*

V. M. NUSSBAUM & CO.
FORT WAYNE, IND.

WE BUY—SELL—REPAIR

All Types of Electrical Machinery. Each One is Rebuilt and Fully Guaranteed

ELECTRIC GENERATOR AND MOTOR CO.
E. 53d St. at Silver Plate Switch, Cleveland

The Bargain Corner of electrical machinery

This is an opportunity for bargain hunters. Select the items you need — all equipment fully guaranteed. Money refunded if not entirely satisfied with purchase.

SLIP RING MOTORS — 3-phase — 60 cycle

Hp.	Make	Type	Speed
200	Lincoln		600
150	Westinghouse	CW	900
125	General Electric	IM	720
100	Westinghouse	CW	900
50	Westinghouse	MW	680
50	Westinghouse	CW	900
25	Westinghouse	CW	1200
20	General Electric	ITC	1200
15	General Electric	MT	600
15	General Electric	MT	1200
10	Allis Chalmers	ARY	600
10	General Electric	MT	1200
7½	General Electric	MT181	700/1690
7½	Westinghouse	CW	500/1160
3	General Electric	MT731	700/1690

ARC WELDERS—Complete Welder with Motor — Stabilizer — Regulator — 200 amp.—300 amp.—400 amp.—500 amp.—600 amp.

Write for catalog describing thousands of machines all at bargain prices.

The MOTOR REPAIR & MFG. CO.

1547 Hamilton Ave. Cleveland, Ohio

TRANSFORMERS

A Complete Stock
Prompt Shipment
Low Prices

We Rewind, Repair and Redesign all Makes and Sizes

ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
Write for Catalog No. 125-D

THE ELECTRIC SERVICE CO., Inc.

AMERICA'S USED TRANSFORMER CLEARING HOUSE

212 Walnut Street CINCINNATI, OHIO

Alphabetical Index to Advertisers

Alemite Corp. 17
Allen-Bradley Co. . . . . 4th Cover
Allis-Chalmers Mfg. Co. . . . . 2nd Cover
American Cable Co. 42
American Fixture Co. 39
American Pulley Co. 25
Atco Products Corp. 57
Audit Bureau of Circulations. 52

Bartlett Hayward Co., The . . . Insert, 29, 30
Biddle, James G. 57
Bussmann Mfg. Co. 37

Century Electric Co. 47
Cities Service Oil Co. 41
Clark Controller Co. 55
Cutler-Hammer, Inc. 13, 61

Dayton Rubber Mfg. Co. 44

Electric Controller & Mfg. Co., The 31
Electric Storage Battery Co., The 7, 48

General Cable Co. 8
General Electric Co. . . . 9, 12, 18, 40, 43, 50
General Electric Vapor Lamp Co. 36

Houghton & Co., E. F. 46

Ideal Electric & Mfg. Co., The 38
I-T-E Circuit Breaker Co. . . . . Third Cover

Leland Electric Co. 55
Linde Air Products Co., The 55
Link-Belt Co. 4-5

McGraw-Hill Book Co., Inc. 38, 54
Mica Insulator Co. 45
Monitor Controller Co. 10
Morse Chain Co. 32

Norma-Hoffmann Bearings Corp. 26

Ohio Valley Pulley Works. 27

Philadelphia Gear Works. 15
Power Transmission Section 19-28
President's Organization on Unemployment Relief. 28
Pure Oil Co., The 24

Reeves Pulley Co. 25
Republic Rubber Co. 51
Rockbestos Products Corp. 49
Rockwood Mfg. Co. 27
Roebling's Sons Co., John A. 11

Safety Car Heating & Lighting Co. 54
Searchlight Section 57-59
Square D Co. 62
Standard Pressed Steel Co. 39
Steelcity Furnace Co. 39

Taylor Instrument Cos. 53
Thompson Electric Co., The 38
Timken Roller Bearing Co., The 35
Trumbull Electric Mfg. Co., The 16

Wagner Electric Corp. 14
Westinghouse Electric & Mfg. Co. 34
Weston Electrical Instrument Corp. 33
Wiegand Co., Edwin L. 6
Wing Mfg. Co., L. J. 56
Worthington Pump & Machinery Corp. 22, 23

SERVICE SECTION

Asphalt Products Co., Inc., The 57
Burrshel Company, Inc., The 57
Chicago Gear Works. 57
Union Products Co., The 57

SEARCHLIGHT SECTION

Classified Advertising

Educational 58
Employment 58
Employment Service 58
Equipment, New and Rebuilt 58-59
Electric Service Co., Inc. 59
Everetts, Albert A. 58
Electric Generator & Motor Service. 59
Gregory Electric Co. 59
Hall & Co., Inc., Stephen 59
Hemphill & Co., J. L. 59
Motor Repair & Mfg. Co. 59
Motor Service Co. 58
Nussbaum & Co., V. M. 59
Rockford Power Mchy. Co. 59

Instead of an ordinary type A Safety Switch
You NOW can have the
C-H 4101 Current Breaker

THE PRICE HAS BEEN CUT

NOW USE THIS 4101 CURRENT BREAKER FOR ALL TYPE A PURPOSES. The C-H 4101 is for all voltages and conditions up to 600 volts D. C. and 575 volts A. C.

THE price on the most desirable of C-H Safety Switches, the 4101 Mill Duty Current Breaker, has been reduced—reduced enough to put this admittedly superior switch on same price basis as Type A switches. Now no reason is left for not using this super switch on the difficult jobs and on all Type A applications as well!

The C-H 4101 *Mill Duty* Current Breaker is the ace of the great C-H Safety Switch line. It easily handles excessive overloads with practically no arcing and will stand up under extreme service indefinitely. A *plus* service at *reduced* cost! Give your plant the best! Take advantage now of the revised price! Your electrical wholesaler has them, or write us. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus*, 1309 St. Paul Avenue. Milwaukee, Wisconsin.

WHAT THE C-H 4101 CURRENT BREAKER BRINGS YOU AT TYPE "A" SWITCH COST . . .

1. Double break air blanketed contactors halve the voltage rise, cut arc to nearly nothing.
2. Non-current-carrying hinges eliminate local burning, and cut all chances of shorting thru the blades, cross-bar or handle.
3. Positive operation even if spring is broken.
4. Unit base construction prevents electrical "creepage."
5. Interlocked safety cover (except non-fusible 200 amp. and over).
6. Milled clip construction.
7. Handles heavy overload, repeated operation, hardest service, easily.
8. No live parts exposed when cover is open.
9. Copper parts cadmium-plated.
10. Quick make and quick break.
11. Case arranged for padlocking.
12. Revised price.

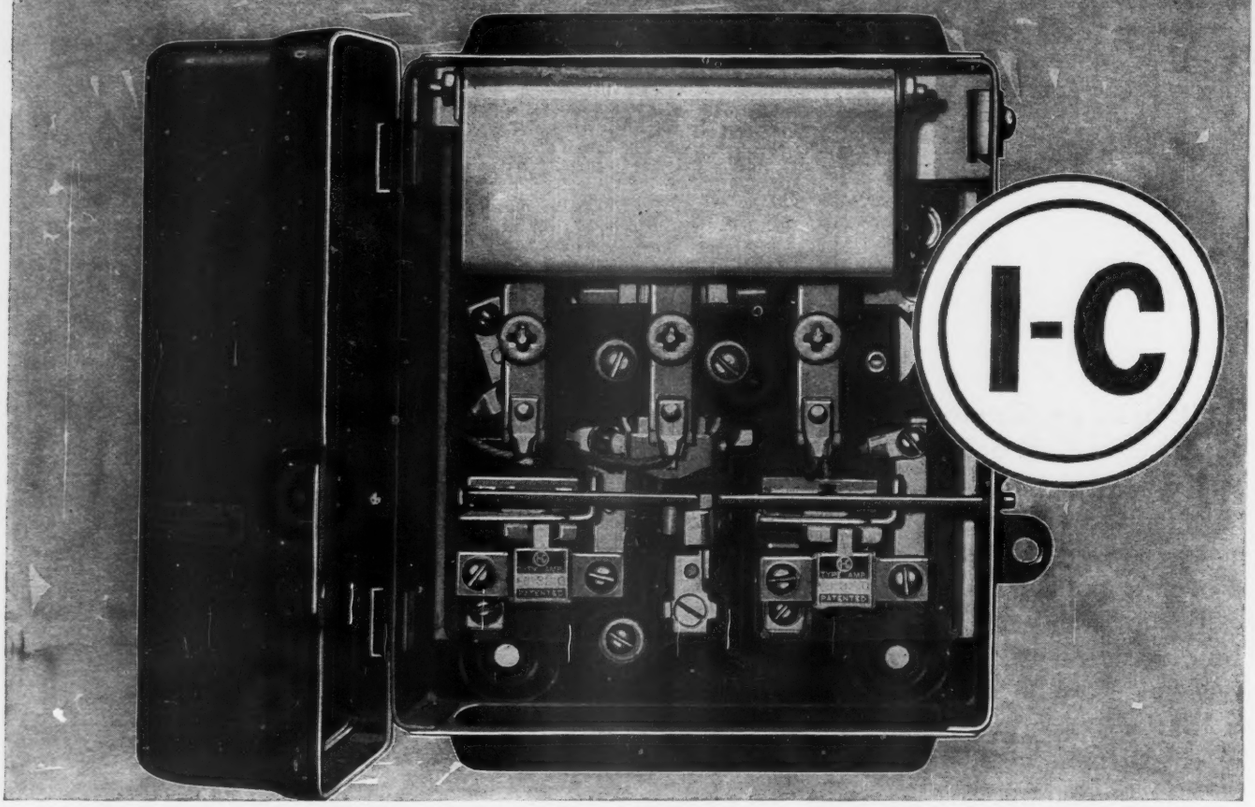
There's no reason left for not equipping with the 4101!

CUTLER HAMMER

High Quality Safety Switches For Every Service

A-5056

IT'S A MATTER OF DOLLARS AND CENTS



It's a matter of Dollars and Cents—this control problem. One failure of the control equipment may necessitate repairs to the motor amounting to much more than the original cost of **reliable starting equipment.**

That is one reason why so many I-C Class 8532 Automatic Starters are being specified. Control buyers realize that the **fixed thermal overload relays,** which cannot be tampered with (but may be **quickly changed** to another rating by an authorized person) safeguard important equipment.

Class 8532 Starters are protected against welding of the contacts by the positive wiping action of the **rugged contact fingers** and **heavy contact pressure** assures ample carrying capacity. When used with a momentary contact type push button **low-voltage protection** is secured. The arc barriers are hinged and cannot be misplaced, the contacts are accessible and there is **ample wiring space.**

Consult any Square D Branch Office regarding your control requirements or write directly to the INDUSTRIAL CONTROLLER DIVISION, SQUARE D COMPANY, 710 SOUTH THIRD ST., MILWAUKEE, WIS.

Affiliated with
DIAMOND ELECTRICAL MFG. CO. LTD.
Los Angeles San Francisco

SQUARE D COMPANY, CANADA, LTD., WALKERVILLE, ONTARIO
Toronto Montreal

SQUARE D

ELECTRICAL EQUIPMENT

Factories at
DETROIT, MICHIGAN, MILWAUKEE, WISCONSIN, AND PERU, INDIANA

SQUARE D COMPANY OF TEXAS
Houston

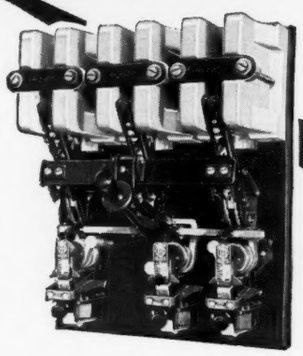
206

3 MAJOR DEVELOPMENTS IN AIR CIRCUIT BREAKERS

MIN-ARC-ITE

RE-AX-ITE

DUAL OVERLOAD



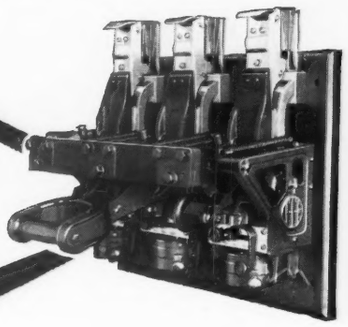
MIN-ARC-ITE — the new I-T-E Arc Extinguisher — is the answer to the increasing demand for higher interrupting capacities and shorter arc duration. It is equally as effective for D. C. as for A. C.

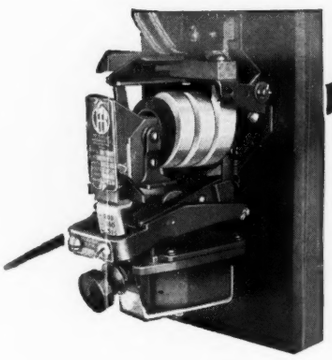
WHAT MIN-ARC-ITE DOES

(1)—Greatly decreases size and time of arc.
(2)—Reduces to a minimum the ionized gases emitted on shorts.
(3)—Adds protection to main contacts and speeds breaker opening.
(4)—Increases rupturing capacity and therefore increases factors of safety.

RE-AX-ITE Carbon Supports are the latest development of a magnetic principle established by I-T-E 31 years ago. Re-Ax-Ite Carbon Supports:

(1)—Speed the opening on short circuits.
(2)—Increase rupturing capacity by affording positive protection to main contacts.
(3)—In combination with Min-Arc-Ite Barriers, provide materially higher interrupting capacity.





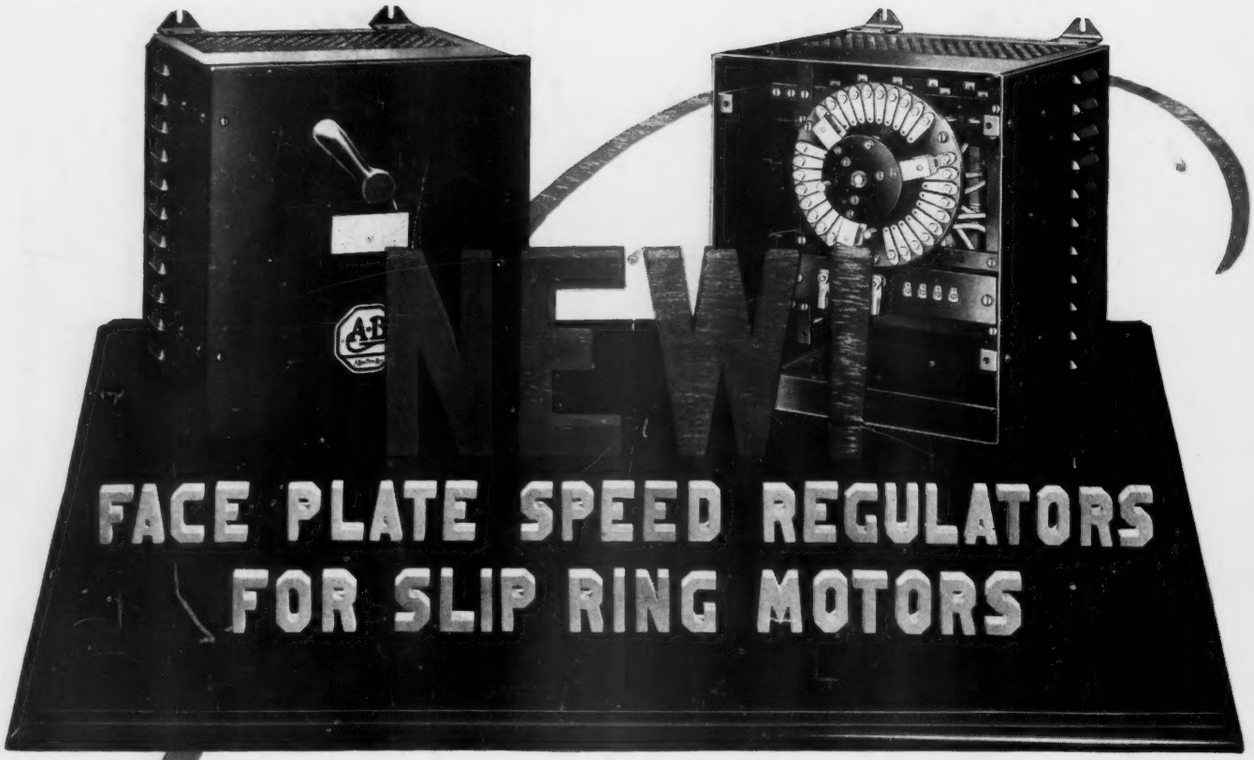
DUAL OVERLOAD — An exclusive I-T-E feature. Discriminates between desired overloads and non-desired overloads or shorts.

(1)—Positive and accurate, due to series overload coils.
(2)—Extremely selective, due to double armatures.
(3)—The most dependable device for starting A. C. motors across the line, giving full protection against sustained overloads and instantaneous opening on shorts.

I-T-E CIRCUIT BREAKER COMPANY, 19TH AND HAMILTON STS., PHILADELPHIA

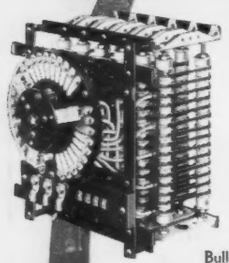
Birmingham, Crawford Bldg.; **Boston,** 201 Devonshire; **Buffalo,** Ellicott Sq. Bldg.; **Chicago,** 333 N. Michigan Ave.; **Cincinnati,** Union Trust Bldg.; **Cleveland,** Terminal Tower Bldg.; **Dallas,** Burt Bldg.; **Denver,** Tramway Bldg., **Detroit,** Penobscot Bldg. **Duluth,** Providence Bldg.; **Kansas City,** Midland Bldg.; **Los Angeles,** 106 W. 3rd; **Minneapolis,** Plymouth Bldg.; **Montreal,** 151 Lagauchetiere St. West; **New Orleans,** 708 Girod St.; **New York,** 12 E. 41st St.; **Omaha,** Electric Bldg.; **Philadelphia,** 1505 Race; **Pittsburgh,** Grant Bldg.; **St. Louis,** Bank of Commerce Bldg.; **San Francisco,** Call Bldg.; **Seattle,** 802 33rd Ave.; **Toronto,** 9 Duke Street; **Vancouver,** 500 Beatty Street; **Winnipeg,** National Cartage Office Building.

UNIVERSITY OF MICHIGAN
ATTEN GENERAL LIBRARY
ANN ARBOR MICH

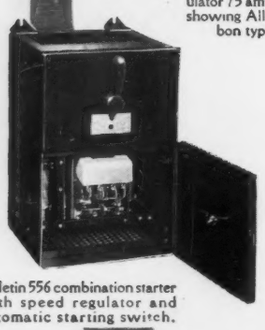


NEW

FACE PLATE SPEED REGULATORS FOR SLIP RING MOTORS



Bulletin 555 A. C. speed regulator 75 ampere face plate, showing Allen-Bradley ribbon type resistance.



Bulletin 556 combination starter with speed regulator and automatic starting switch.

CONSTANTLY growing! The new Bulletin 555 and 556 A.C. Speed Regulators are another important addition to the Allen-Bradley line. They will handle slip-ring motors up to 25 H. P. capacity. Provide speed reduction of 50% for either machine tool or fan duty.

These speed regulators incorporate many new features in design which should appeal to the user. Not only are marked improvements made in the design of the contactor mechanism, but also in the resistors. The complete story will interest you! Send for Bulletins 555 and 556, just off the press. Use the coupon.

Send for Allen-Bradley bulletin today

Allen-Bradley
Electric
Controlling Apparatus

Allen-Bradley Co.
1321 S. First St., Milwaukee, Wis.

Please send us immediately Bulletins 555 and 556, describing the new A-B Face Plate Speed Regulators.

Name ----------

Company ----------

Address ----------